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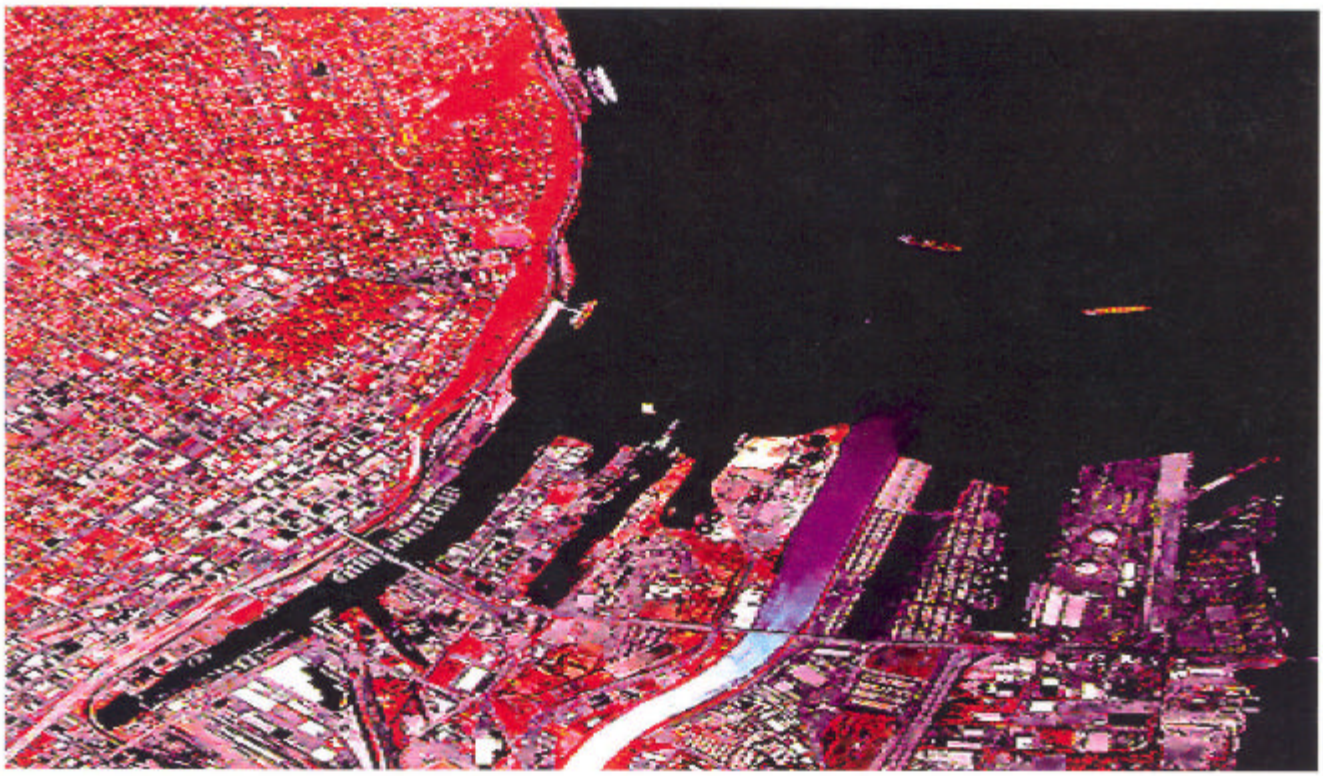
RP/EIS

COMMENCEMENT BAY PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT VOLUME I: DRAFT EIS



Prepared by:

Lead Agencies

U.S. Fish and Wildlife Service

National Oceanic and Atmospheric Administration

June 1996

Cooperating Agencies

Muckleshoot Indian Tribe
Puyallup Tribe of Indians
Washington Department of Ecology
U.S. Environmental Protection Agency
U.S. Army Corps of Engineers

FACT SHEET

Program Title: Commencement Bay Draft Restoration Plan and Programmatic Environmental Impact Statement (RP/EIS)

Lead Agencies: U.S. Fish and Wildlife Service
National Oceanic and Atmospheric Administration

Cooperating Agencies: Washington Department of Ecology
Muckleshoot Indian Tribe
Puyallup Tribe of Indians
U.S. Environmental Protection Agency, Region X
U.S. Army Corps of Engineers, Seattle District

Abstract:

The Commencement Bay Natural Resource Trustees are conducting restoration planning to determine the best approach to restoring, replacing, rehabilitating, and/or acquiring the equivalent natural resources and/or services injured as a result of the release of hazardous substances or a discharge of oil to the Commencement Bay environment. To guide the restoration planning process, the Trustees have elected to prepare an RP/EIS in order to evaluate management alternatives for restoring those injured natural resources.

The RP/EIS evaluated five alternatives: (1) No Action/natural recovery, (2) Species-Specific Restoration, (3) Habitat Function Restoration, (4) Acquisition of Equivalent Natural Resources and Services, and (5) Integrated Approach. The Trustees have concluded that the preferred alternative is the Integrated Approach, which is a comprehensive plan based on the habitat function alternative, but supplemented with the best features of the other alternatives. This alternative best meets the needs of the Trustees' restoration goals and principles by maximizing ecological benefits for a wider range of natural resources and their associated services.

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Comment Period for Draft EIS: The comment period for the Draft RP/EIS ends 60 days after the Notice of Availability is published in the Federal Register. Comments on this RP/EIS should be sent to Judy Lantor at the above address.

Availability of Copies: Copies of the draft RP/EIS are available from the contact persons listed above.

Documents incorporated by reference

Commencement Bay Natural Resource Trustees. 1995. Commencement Bay Phase I Damage Assessment Report (CB/NRDA). Prepared by EVS Environment Consultants for the Commencement Bay Natural Resource Trustees and the NOAA Damage Assessment and Restoration Center, Seattle, Washington.

U.S. Army Corps of Engineers, Seattle District, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration. 1993. Commencement Bay Cumulative Impact Study. Volumes 1 (Assessment of Impacts) and 2 (Restoration Options).

U.S. Fish and Wildlife Service, and National Oceanic and Atmospheric Administration. 1995. Commencement Bay Restoration Plan and Programmatic Environmental Impact Statement Scoping Document, Olympia, Washington.

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EXECUTIVE SUMMARY

The purpose of preparing this programmatic Restoration Plan/Environmental Impact Statement (RP/EIS) is to coordinate and implement restoration projects under the Commencement Bay Natural Resource Damage Assessment (CB/NRDA). This document is not intended to quantify the extent of restoration needed to satisfy claims under applicable law against parties deemed responsible for environmental injury. The scale of restoration activity that will be taken under this RP/EIS will depend upon the funds, property and services made available through resolution of natural resource damage claims.

Volume I is the programmatic Environmental Impact Statement, required by the National Environmental Policy Act for any federal actions which may significantly affect the environment. The EIS analyzes at a programmatic level the environmental impacts of the alternatives that may be employed by the Trustees to restore, replace, rehabilitate, and/or acquire the equivalent of the injured natural resources and the services they would have provided but for the hazardous substance releases or oil discharges to the environment of Commencement Bay.

Volume II is the conceptual Restoration Plan that includes a management plan to evaluate projects in relation to the Trustees' framework, and then becomes an implementation plan when a specific site is selected.

VOLUME 1: ENVIRONMENTAL IMPACT STATEMENT

Purpose and Need

Commencement Bay (the Bay) is a deep-water embayment that occupies approximately 5,700 acres (8.9 square miles) in south Puget Sound, Washington. The Commencement Bay Nearshore/Tideflats (CB/NT) site was added to the National Priorities List after a remedial investigation and feasibility study by the U.S. Environmental Protection Agency (EPA) and the Washington Department of Ecology investigated fish, shellfish, and sediments within the waterways and found them to have elevated concentrations of hazardous substances. The CB/NT Record of Decision identifies contaminated sediment problem areas in the Bay that have elevated concentrations of chemicals of concern, and identifies sediment quality goals and objectives as well as several alternative methods to remediate sediments to obtain these goals.

The Commencement Bay Natural Resource Trustees (Trustees) are developing the CB/NRDA to determine the extent of injuries to natural resources, such as fish, shellfish, wildlife, sediments, and water quality, and the services they provide. The CB/NRDA is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, the Oil Pollution Act of 1990, and other applicable laws. The

Trustees represent the interests of the public in assessing injuries to the natural resources and the services they provide and restoring and compensating the public for such injuries. The Trustees are the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce; the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Indian Affairs of the U.S. Department of the Interior; the State of Washington, including the Departments of Ecology (lead state Trustee), Natural Resources (WDNR), and Fish and Wildlife; the Puyallup Tribe of Indians; and the Muckleshoot Indian Tribe.

Concurrent with the damage assessment process, the Trustees are conducting restoration planning to determine the best approach to restoring, rehabilitating, replacing, and acquiring the equivalent of the natural resources and their associated services. To guide the restoration process, the Trustees are preparing this RP/EIS, with NOAA and USFWS as the lead federal agencies. The cooperating agencies are the other Trustees, the U.S. Army Corps of Engineers, and EPA. The EIS analyzes the environmental impacts of the alternatives that may be employed by the Trustees to restore, replace, rehabilitate, or acquire the equivalent of natural resources and services injured as a result of the release of hazardous substances or the discharge of oil to the environment of Commencement Bay. The Restoration Plan (Volume II) will guide decision making regarding the implementation of CB/NRDA restoration activities. The programmatic EIS is intended to expedite and provide a point of departure for future site-specific projects and facilitate the preparation of subsequent project-specific environmental documents. The programmatic EIS is being conducted in accordance with the National Environmental Policy Act (NEPA), and may be adopted by the State under its State Environmental Policy Act (SEPA). Section 1 provides additional information on the responsibilities of the Trustees as well as the environmental compliance process under which they are conducting this RP/EIS.

Affected Environment

The Affected Environment Section (Section 2) provides detailed descriptions of the existing environmental setting of the primary and expanded study areas and identifies environmental resources or issues that could be affected by the CB/NRDA Restoration Plan.

The primary study area is within or adjacent to the environs of Commencement Bay, and includes the shoreline, intertidal areas, and bottom sediments in subtidal areas and the various waterways. The Port of Tacoma and associated industrial areas occupy the Puyallup River delta at the east end of the Bay. Most of the upland inland area is densely urbanized with extensive industrial, commercial, and mixed use development.

The expanded study area for the RP/EIS includes approximately 600,000 acres (1,000 square miles) of the Puyallup River Basin (Figure 1.2-2). It is comprised of Commencement Bay and its basin, including the main tributaries (the Puyallup, Carbon, and White Rivers) and the coastal areas adjacent to the Bay (southern Vashon and Maury Islands and Dumas Bay).

This area has important ecological connections with injured natural resources (particularly migratory species) that use the Bay.

Habitat Types: Functions, Distribution and Conditions: Previous development actions have fragmented the landscape. The remaining viable estuarine habitats are often separated by altered shorelines or industrial development; migration routes into off-channel habitats are often blocked, preventing two way transfer of energy or individuals of species. Transition zones between habitat types are often lacking. More importantly, chemical contamination has reduced the natural resources value of much of the remaining habitat, whether original or not. The RP/EIS concludes, however, that despite physical and chemical modifications, many of the remaining habitats in the Bay support or have the potential, if properly restored, to support some or all of the life stage requirements for the biological resources of the Bay that have been injured as a result of releases of hazardous substances or a discharge of oil.

Key Resources and Services: The Trustees identified in the study areas a number of key natural resources that have been injured by the release of hazardous substances or the discharge of oil including salmonids, flatfish, benthic infauna, epibenthic invertebrates, larger invertebrates and birds. Some of the major services provided by these natural resources include recreational, non-consumptive uses, passive uses, and Tribal services. Threatened and endangered species are known to occur in the study areas.

Geology, Soils, Topography, and Surface Water Hydrology: Commencement Bay is surrounded predominantly by flat coastal beaches and tidal flats. Steep shoreline bluffs with high erosion and slippage hazards border the estuary to the north and south. The Puyallup River is the principal source of both fresh water and sediment to the Bay, though Hylebos and Wapato Creeks also contribute flows to the Bay. Tidal currents in the Bay are quite strong compared to many other deep-water areas of Puget Sound and are sufficient to induce substantial resuspension of fine sediments of the deep Bay.

Glacial till left behind by retreating glaciers is generally found in upland deposits in the primary study area, while alluvial deposits underlay most of the major river valleys in the expanded study area. Soils adjacent to Commencement Bay consist almost entirely of fill material (artificially modified surface material) overlying natural delta sediments.

Water and Sediment Quality: Releases of hazardous substances from businesses, industry, municipalities, and other sources in the Commencement Bay area have resulted in significant declines in the quality of water and associated sediments. The history of industrial use, high urban density, and instream flow diversion have contributed to significant water quality degradation resulting from elevated bacterial levels, higher than normal temperatures, chemical pollutants in the water and sediments, and habitat degradation. Other surface water quality issues include instream flows, gravel removal activities impacting fish habitat, storm water discharges from municipal and industrial sources, lack of control

of pollution from unregulated sources, wastewater discharges from municipal and industrial facilities, and construction of impervious surfaces in groundwater recharge zones. Sediment quality issues include contaminant releases from industrial and commercial activities and nonpoint sources of pollution.

Air and Noise Quality: Air quality conditions in the study area are influenced by several factors, including climate, topography, industrial and residential pollution sources, and vehicular air emissions.

Land Use and Aesthetics: The land use attributes considered include general use patterns, ownership and management, as well as the area's aesthetic qualities and access opportunities.

Population, Housing, and Transportation: The Tacoma Metropolitan Statistical Area, consisting of Pierce County, has shown a pattern of consistent moderate population growth since 1980, and is projected to continue growing with the population reaching about 850,000 people in 2020. Increased population growth may increase pressure upon land available for restoration and impose ecological stress upon restoration sites.

Cultural Resources: The study areas were historically occupied by the ancestors of the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe. Fishing for salmon, steelhead trout, and shellfish are central to the spiritual, cultural, subsistence, and economic well-being of members of both tribes. Archeological sites have been investigated in the study areas, a majority of which have been situated in the coastal and lowland zones. The Federal Office of Archaeological and Historical Preservation indicates a number of sites and districts are listed on the National Register of Historic Places or are designated as National Historic Landmarks.

Alternatives

Since this is a programmatic EIS, the management alternatives reflect general approaches to the restoration of natural resources and services injured as a result of releases of hazardous substances and discharges of oil in the Commencement Bay environment. The five alternatives being evaluated are: (1) No Action, (2) Species-Specific, (3) Habitat Function, (4) Acquisition of Equivalent Natural Resources and Services, and (5) Integrated Approach. The analysis in this draft EIS applies to the alternatives and the variation in types of actions that could be utilized to achieve restoration but does not consider individual site-specific actions. Appropriate NEPA/SEPA project-specific environmental analysis will be conducted for all future restoration activities.

Alternative 1: No Action: The "No Action" alternative required by NEPA consists of expected conditions under current programs and regulations pursued by tribes and agencies outside the NRDA process. It is the base against which other actions can be compared. If

this alternative were implemented, the Trustees would not undertake any CB/NRDA restoration projects.

Alternative 2: Species-Specific Restoration: This alternative focuses on a specific species or a group of species injured from the release of hazardous substances and discharge of oil, as identified in the CB/NRDA process, rather than on the restoration of generic habitat units and patches. Focal species could be ecological keystone species or economically or socially valuable species that have been injured. Species-specific restoration would be considered in situations where: (1) species may recover after remediation efforts (e.g., contaminant removal and implementation of source control) have been implemented but where additional activities would be required to facilitate their recovery; (2) species are unable to recover as part of a general habitat restoration program following any site remediation and source control; and (3) the target species or natural resource plays such an important ecological role that restoration would produce significant benefits to other injured natural resources and services.

Alternative 3: Habitat Function Restoration: This alternative involves actions designed primarily to benefit certain habitat types that support a range of species. This alternative assumes that if functional habitat is created, use by injured species will follow, and injured species and services will be restored. It further assumes that more diverse habitat will yield a greater diversity of biota. The goal of this alternative is (1) to restore habitats that provide functional benefits (e.g., feeding, refuge, reproduction) to multiple natural resources and services injured as a result of the release of hazardous substances or discharges of oil, or (2) to purchase and enhance existing functional habitats that would provide direct benefits to injured natural resources and services.

Alternative 4: Acquisition of Equivalent Natural Resources and Services: Under this alternative, projects and activities would focus on the acquisition of equivalent natural resources and services which would be the same or substantially similar to the natural resource or service which was injured but which could not otherwise be restored. Substantially similar resources or services are those which ensure that the resources or services provided after the release of hazardous substances or discharges of oil are as close as possible to the resource and service conditions that would have existed if the release or discharge had not occurred.

Alternative 5: Integrated Approach: The goal of this alternative is to maximize the opportunities for restoring, replacing, rehabilitating or acquiring natural resources and services injured as a result of the release of hazardous substances or discharges of oil, by integrating the best elements of the other alternatives (i.e., habitat function, species-specific, and acquisition of equivalent resources and services). As a comprehensive plan to restore injured species in the Bay and Basin, the integrated approach is based primarily on the habitat function alternative, which forms the core of the integrated approach, as well as specific components from the species-specific and acquisition of equivalent natural resources

and services alternatives that will assist with (1) restoration of injured resources in the interim while habitat restoration is developing into a fully functioning system, and (2) recovery of those resources that require additional measures to achieve restoration.

The five management alternatives were screened using evaluation criteria developed to evaluate each alternative's ability to meet the goals and objectives of the CB/NRDA restoration program (see also Appendix E and Volume II). The screening process eliminated the Species-Specific and Acquisition of Equivalent Natural Resources and Services Alternatives from further consideration due to the greater adverse environmental impacts associated with these alternatives, and the lesser ability of these alternatives to meet the goals and objectives of the NRDA restoration program. The No Action, Habitat Function and Integrated Approach Alternatives are brought forward for a full evaluation of environmental consequences.

Environmental Consequences

The environmental consequences discussion includes the environmental direct, indirect, and cumulative impacts of the alternatives, any adverse environmental effects that cannot be avoided should the alternative be implemented, the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity, any irreversible or irretrievable commitments of resources, and the environmental consequences of implementation. Summaries are provided of possible restoration actions and their potential implementation impacts, including potentially applicable mitigation measures to avoid or minimize the adverse environmental impacts.

Based on these evaluations, the Trustees concluded that their preferred alternative is the Integrated Approach, which is a comprehensive plan based on the habitat function alternative, but supplemented with the best features of the other alternatives. It is believed that the preferred alternative has the highest probability of meeting the needs of the Trustees' restoration goals and objectives because it maximizes the ecological benefits for a wider range of natural resources and services.

Coordination and Compliance Issues

This section provides information on laws and regulations which must be complied with on a project-specific level, as well as information on other plans, policies, and programs instituted by those authorities which may need to be taken into consideration.

VOLUME II: RESTORATION PLAN

The Restoration Plan provides a framework for translating the Integrated Approach, the preferred alternative of the EIS, into on-the-ground restoration projects. If the Integrated Approach is ultimately selected as the Trustees' management approach, the Conceptual Restoration Plan provided in the draft RP/EIS will become the final and operative Restoration Plan for the CB/NRDA restoration activities.

1.0 PURPOSE AND NEED

1.1 Program Background

The **purpose** of preparing this programmatic Restoration Plan/Environmental Impact Statement (RP/EIS) is to restore, replace, rehabilitate, and/or acquire the equivalent natural resources and services injured as a result of hazardous substances or the discharge of oil to the environment of Commencement Bay. The **proposed action** of the RP/EIS is to develop a restoration plan for Commencement Bay which will be utilized to coordinate and implement restoration projects under the Commencement Bay Natural Resource Damage Assessment (CB/NRDA). The restoration plan is being developed prior to final resolution of damage claims so that existing settlement funds may be utilized to implement restoration projects. The RP/EIS is not intended to quantify the extent of restoration needed. The ultimate scale of restoration activity that will be undertaken as a result of this RP/EIS will depend upon the funds, property and services made available through resolution of natural resource damage claims.

Commencement Bay is a deep-water embayment that occupies approximately 5,700 acres in south Puget Sound, Washington (Figure 1.1-1.). The Bay was placed on a national interim list of 115 highest priority hazardous waste sites on October 23, 1981 (EPA, 1989). The Commencement Bay Nearshore/Tideflats (CB/NT) site was added to the National Priorities List after fish, shellfish, and sediments within the waterways were found to have elevated concentrations of hazardous substances. In 1983, the U.S. Environmental Protection Agency (EPA) and the Washington Department of Ecology (Ecology) initiated a remedial investigation and feasibility study (RI/FS). A Record of Decision (ROD) for the site was completed in 1989 (EPA, 1989). The ROD identifies contaminated sediment problem areas in Commencement Bay that have elevated concentrations of chemicals of concern. The ROD also identifies sediment quality goals and objectives as well as several alternative methods to remediate sediments to obtain these goals.

The Commencement Bay Natural Resource Trustees (Trustees) are conducting the CB/NRDA to determine the extent of injuries to natural resources resulting from the release of hazardous substances or the discharge of oil. The CB/NRDA is being conducted pursuant to the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. § 9601, et seq. (CERCLA), the Oil Pollution Act of 1990, 33 U.S.C.§§ 2701-2761 (OPA), and other applicable laws. The natural resources covered by the CB/NRDA include fish, shellfish, wildlife, sediments and water. The Trustees represent the interests of the public in assessing injuries to, and restoring, the public's natural resources. The Trustees have a responsibility to recover damages from parties who have caused injury to Commencement Bay natural resources. The assessed damages (whether in the form of money, land or in-kind services) are intended to be sufficient to restore injured natural resources to the levels of function and service they would have provided but for the injuries, and also to recover for losses suffered by the environment and the public during the period before injured resources are restored or naturally recover.

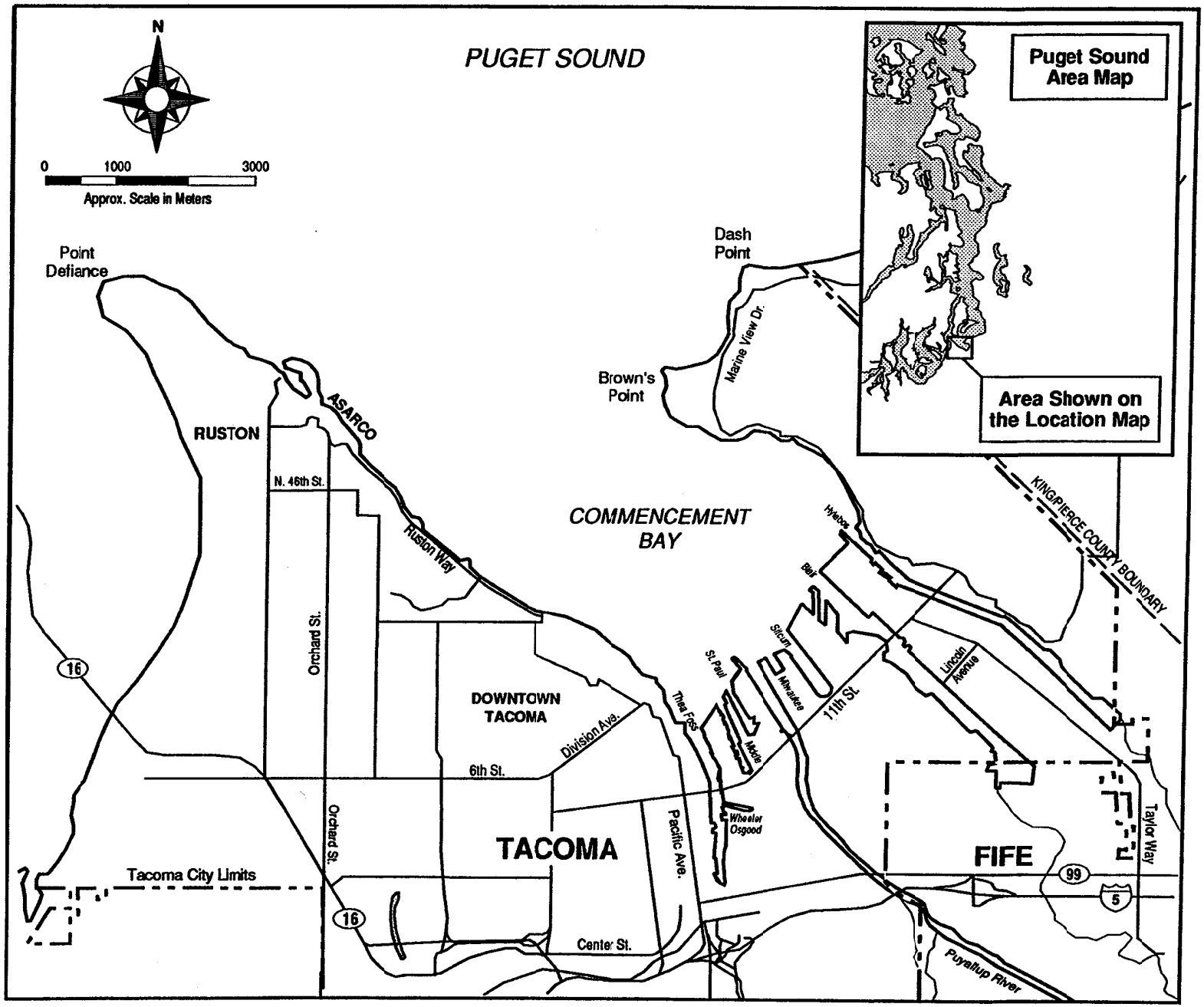

Figure 1.1-1. Commencement Bay.

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The Trustees are the National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce; the U.S. Department of Interior (DOI), which includes the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Indian Affairs (BIA); the Washington Department of Ecology (Ecology)—lead state Trustee; the Washington State Departments of Natural Resources (WDNR) and Fish and Wildlife (WDFW); the Puyallup Tribe of Indians; and the Muckleshoot Indian Tribe. NOAA and USFWS are the lead federal agencies for preparing the Restoration Plan/Environmental Impact Statement (RP/EIS). The cooperating agencies are the other Trustees, the U.S. Army Corps of Engineers (Corps) and EPA. The Trustee agencies are the decision makers for the RP/EIS. Following review and finalization of the RP/EIS, the Trustees will be responsible for selecting one of the restoration plan approaches for implementation.

Concurrent with the CB/NRDA process, the Trustees are conducting restoration planning to determine the best approaches to restoring, rehabilitating, replacing and acquiring the equivalent of the injured natural resources and services they provide. As the CB/NRDA has progressed, the Trustees have entered into partial or full settlements of claims with Simpson Tacoma Kraft Co., Champion International Corp., Washington Department of Natural Resources, and the Port of Tacoma. To guide the restoration actions to be taken in implementing these and future settlements, the Trustees are preparing this RP/EIS. The Environmental Impact Statement analyzes the environmental impacts of the alternatives that may be employed by the Trustees to restore, replace, rehabilitate, and/or acquire the equivalent of natural resources and services injured as a result of the release of hazardous substances or the discharge of oil to the environment of Commencement Bay. The Restoration Plan (Volume II) will guide decision-making regarding the implementation of natural resource restoration activities.

The RP/EIS accomplishes the NRDA restoration planning process by evaluating five programmatic approaches to restoration in the Commencement Bay area, and assessing the associated environmental consequences with these approaches. The RP/EIS includes:

Volume I:

The EIS, which contains the impact analysis of the five alternatives, a glossary and a list of acronyms.

Appendix A is an assessment of avian use in Commencement Bay. This material was produced to assist in the evaluation of environmental consequences and to provide background on the affected environment.

Appendix B contains a memorandum that provides an overview of the preliminary scoping meeting and written correspondence that has occurred after the Scoping Summary Document including comment letters on the advance draft RP/EIS and background coordination on the Endangered Species information contained in the RP/EIS.

Appendix C provides an in-depth evaluation of the habitats in the Commencement Bay area and an analysis of landscape metrics over a portion of the primary study area.

Appendix D includes information on the natural resources in the study areas.

Appendix E provides a detailed analysis of alternatives eliminated from further evaluation.

Volume II:

A conceptual Restoration Plan that includes a management plan for implementation of specific restoration projects as well as an inventory of potential restoration sites that was developed by the Commencement Bay Restoration Technical Panel (see Volume II section 1.2 for a description of the Panel).

1.2 Study Area

Commencement Bay is an estuarine bay at the southern end of Puget Sound. The Bay is surrounded on three sides by the industrial, commercial, and residential sections of the City of Tacoma, the City of Fife and the Town of Ruston. Tacoma's downtown area is located along the southern shore of the Bay. The Port of Tacoma and its associated industrial areas occupy the Puyallup River delta at the east end of the Bay.

A primary study area and expanded study area were identified during the RP/EIS scoping process (Figures 1.2-1. and 1.2-2.). The primary study area for the RP/EIS includes Commencement Bay, referred to herein as "the Bay", that portion of Puget Sound enclosed by a line from Browns Point to Point Defiance; and the Puyallup valley eastward to State Highway 161, inclusive of both the Wapato and Hylebos Creek drainages. The expanded study area includes the Puyallup River Basin (Basin), and is comprised of Commencement Bay and its watershed, including the main tributaries (the Puyallup, Carbon, and White Rivers) and the Puget Sound coastal areas adjacent to the Bay (southern Vashon and Maury Islands and Dumas Bay). The Bay and Basin occupy approximately 1,000 square miles. Within the study area, the RP/EIS will focus on those areas that serve as habitat for, or otherwise support, the natural resources of Commencement Bay that have been potentially injured as a result of releases of hazardous substances and discharges of oil. The Trustees will undertake restoration actions within the expanded study area only where they conclude that they cannot successfully implement the preferred restoration alternative within the primary study area alone. Consideration of the entire Commencement Bay watershed is a prudent way to address all reasonably foreseeable impacts.

1.2.1 Primary study area

The upland boundaries of the Commencement Bay area are defined according to contours of localized drainage basins that flow into the marine waters (Figure 1.2-1.). The marine boundary of the site is limited to the shoreline, intertidal areas, bottom sediments, and open

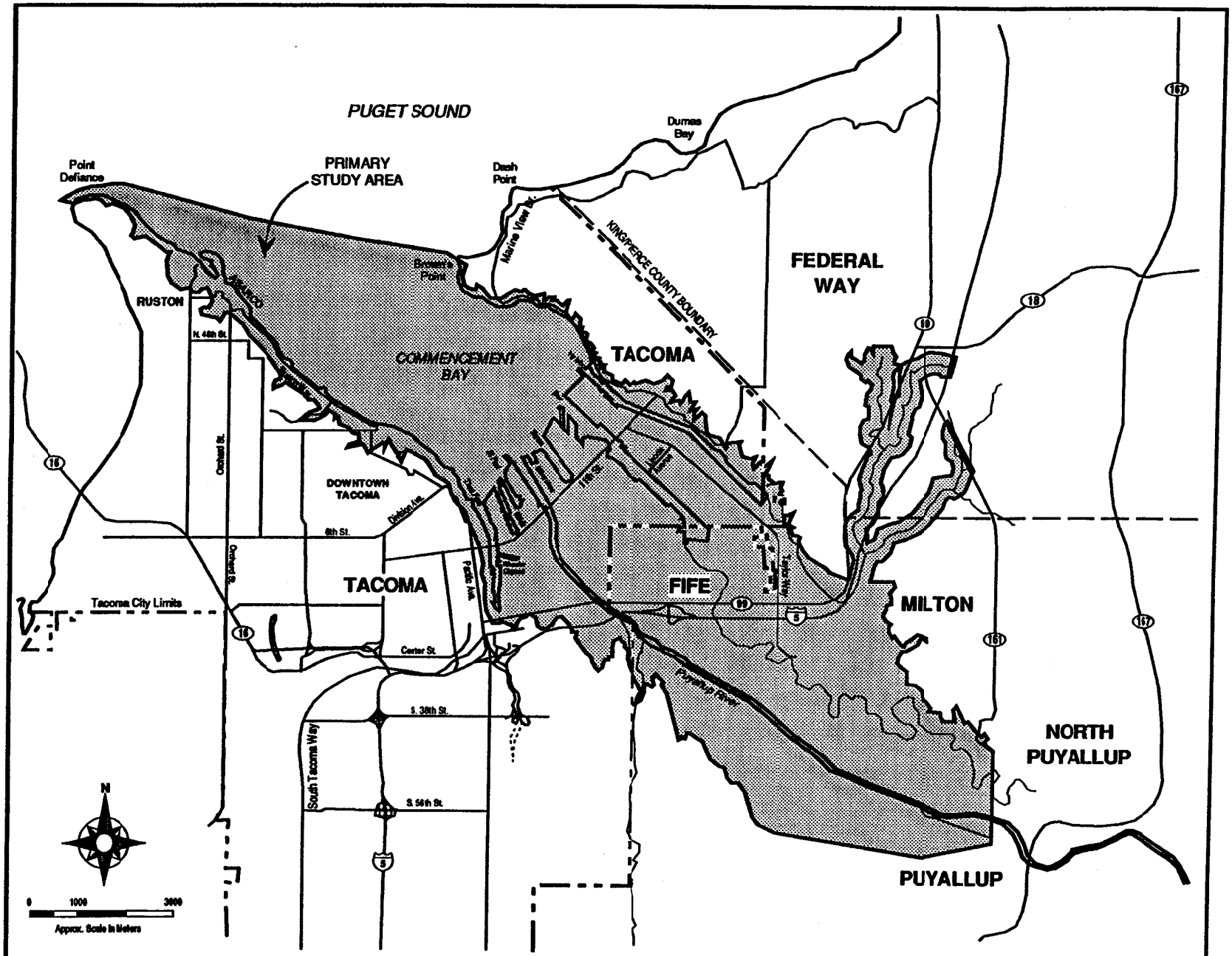

Figure 1.2-1. The Primary Study Area (shaded).

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water. The nearshore portion of the site is defined as the area along the Ruston shoreline from the mouth of the Thea Foss Waterway to Point Defiance, and the area from the mouth of the Hylebos Waterway to Brown's Point. The tideflats portion of the site includes the Hylebos, Blair, Sitcum, St. Paul, Middle, Wheeler-Osgood, and Thea Foss Waterways, including remnants of the Milwaukee Waterway; the Puyallup River upstream to the SR-161 bridge; and the adjacent land areas. The entire primary study area is approximately 16,000 acres (25 square miles) in size.

Commencement Bay has become a center of urban development in Puget Sound because it offers a protected deep water harbor in proximity to abundant freshwater resources and transportation corridors. The Puyallup River and Hylebos and Wapato Creeks all contribute considerable flows to the Bay and simultaneously provide a proportionate amount of the sediment load (Corps et al., 1993).

1.2.2 Expanded study area (Puyallup River Basin)

The restoration area was expanded to include approximately 600,000 acres of additional area in the Puyallup River Basin that have important ecological connections with natural resources (particularly migratory species) of Commencement Bay. The Puyallup River drains an area of approximately 1000 square miles of mountains and lowlands, and discharges an average of 1.1×10^{11} cubic feet of water annually (Figure 1.2-2.).

The following may compel the Trustees to look beyond the primary study area for potential restoration sites:

- site use restrictions and lack of available sites for restoration within the primary study area;
- contaminant source control limitations;
- limited functional benefits to injured natural resources, because of the extent of physical and chemical modification to the Bay;
- lack of economically and ecologically viable restoration options in the Bay; and
- the necessity for each restoration action to provide benefits to injured resources and/or services throughout their geographical range.

In addition, the probability of successfully meeting NRDA restoration goals may increase by considering the expanded study area, because:

- restoration sites in the expanded study area may predictably increase populations of selected injured species better than restoration sites in the Bay;
- restoration sites in the expanded study area may be better connected to existing viable habitats, have better buffers, allow greater access, and have a higher probability of long-term self-maintenance; and
- restoration of sites in the expanded study area may be more cost effective.

1.3 Project Goals and Objectives

The three primary goals of the Commencement Bay restoration planning process, which were identified in the RP/EIS Scoping Document (USFWS & NOAA, 1995), are to:

1. Meet the statutory objectives of restoring, replacing, rehabilitating, and/or acquiring the equivalent of natural resources injured or destroyed as a result of the release of hazardous substances or discharges of oil.

2. Provide alternatives for those natural resources that will not recover without efforts above and beyond regulatory requirements for source control, sediment cleanup, and habitat restoration (e.g., certain fish and wildlife species, and water quality).

3. Provide a diversity of sustainable habitat types and species within the Commencement Bay ecosystem to enhance fish and wildlife resources.

These objectives developed by the Trustees for the RP/EIS are similar to the objectives identified by the Commencement Bay Natural Resource Damage Assessment Restoration Technical Panel. See the Conceptual Restoration Plan, Volume II, sections one and three for a more detailed discussion. The objectives are:

1. Provide a functioning and sustainable ecosystem where selected habitat and species of injured fish and wildlife will be enhanced to provide a net gain of habitat function beyond existing conditions.

2. Integrate restoration strategies to increase the likelihood of success.

3. Coordinate restoration efforts with other planning, regulatory and State proprietary activities to maximize habitat restoration.

1.4 Programmatic NEPA/SEPA Process

Environmental impact statements may be prepared for broad Federal actions such as adoption of new agency programs or regulations (40 CFR 1502.4(b)). These globally derived environmental impact statements are called "Programmatic". The purposes of preparing a programmatic EIS are to expedite and provide a point of departure for future site-specific projects, and to facilitate the preparation of subsequent project-specific NEPA and State Environmental Policy Act (SEPA) documents through the use of "tiering" or "phasing". Utilizing the concepts developed in the RP/EIS, environmental review of future projects, whether large or small, may adopt this tiering approach (40 CFR1502.4(d)). These future projects would focus on site specific issues and impacts and would incorporate by reference the relevant aspects of the RP/EIS. By utilizing this flexible approach, the future projects

in the secondary and tertiary tiers can use the complete range of environmental evaluation provided by the NEPA/SEPA process (i.e., Environmental Impact Statements, Supplemental Environmental Impact Statements, Environmental Assessments with findings of no significant impact, Determination of Non-significance, Mitigated Determination of Non-significance and, perhaps, categorical exclusion). Figure 1.4-1. presents a flow chart of the major steps in the NEPA process for this programmatic RP/EIS. Following review and finalization of the RP/EIS, the lead agencies will issue a Record of Decision that identifies the alternative to be implemented for natural resource restoration. Project specific NEPA and SEPA documents will be prepared for each project proposed under the selected restoration approach. The process for implementing the selected approach and its component projects is described in Volume II of this RP/EIS.

Because the Trustees include state agencies as well as federal agencies and tribal governments, the EIS being prepared under NEPA is intended to fulfill all the requirements of the Washington State Environmental Policy Act (SEPA) and may be adopted by Ecology.

1.5 Summary of the Scoping Process

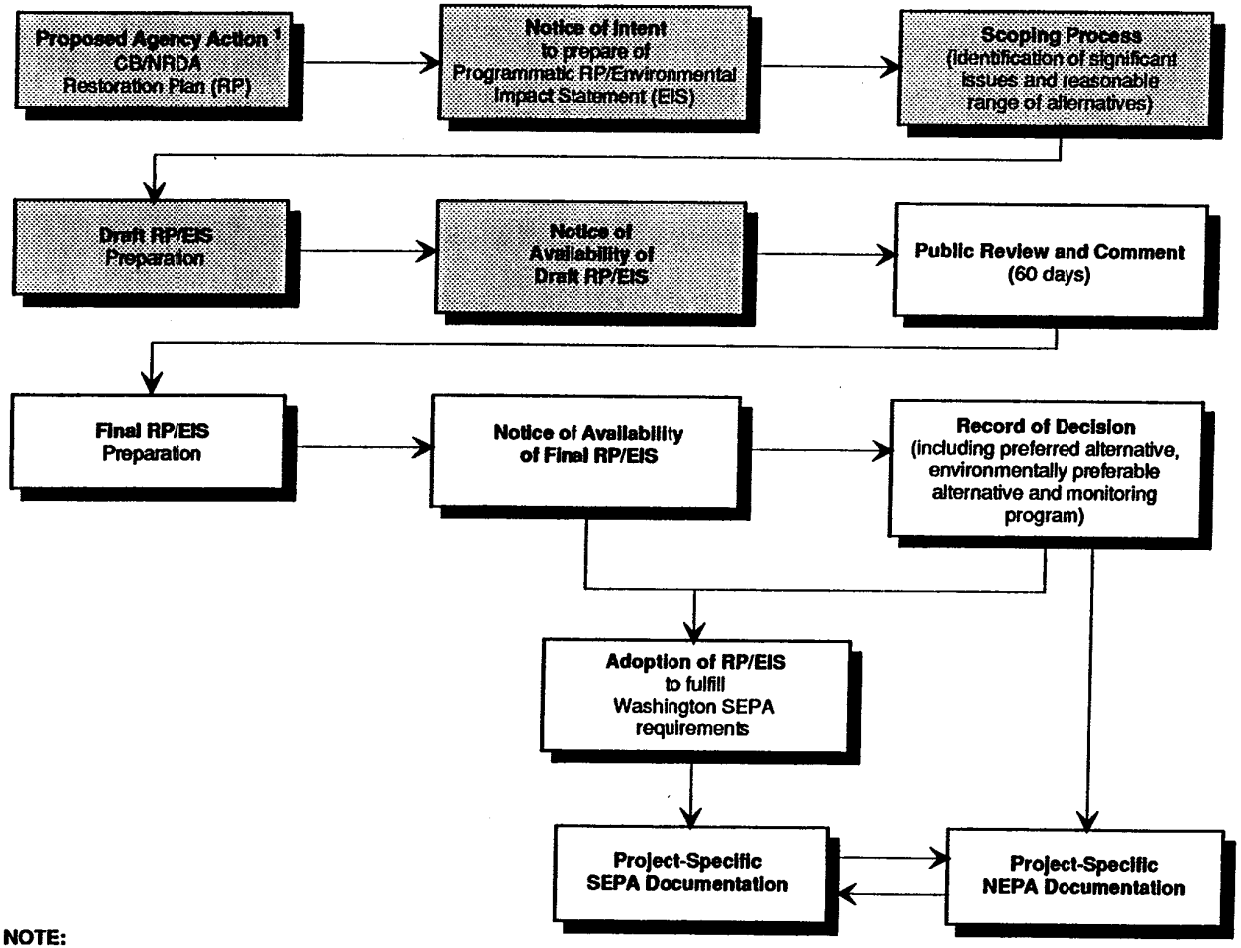
The first step in preparing the draft RP/EIS is to define the scope or limits of the work, generally termed as "scoping." The description of the scoping process for the RP/EIS is summarized from the CB/RP/EIS Scoping Document (USFWS and NOAA, 1995), which should be consulted for additional details of the scoping conducted for the project.

1.5.1 Public notice and comment period

The Notice of Intent (NOI) to prepare the Commencement Bay RP/EIS was published by the U.S. Army Corps of Engineers, on behalf of NOAA and the USFWS, in the *Federal Register* (59 Fed. Reg. 44711-2) on Tuesday, August 30, 1994. In this notice, the public was invited to provide written comments on the scope and content of the RP/EIS, questions about the RP/EIS, requests for inclusion on the RP/EIS mailing list, and requests for copies of any documents associated with the draft RP/EIS. The comment period ended on October 14, 1994.

1.5.2 Scoping meetings

Scoping meetings were held to provide the public with an early opportunity to engage in discussions regarding the RP/EIS and to provide oral and written comments. Two informal meetings were held on September 21, 1994, to provide an opportunity for the public to engage in discussions with the Trustees and to ask questions. A separate formal meeting was held two weeks later to receive public comments on the scope of the RP/EIS. All three meetings were held at the World Trade Center in Tacoma, Washington. The times and locations of scoping meetings were publicized in display advertisements in local newspapers. In addition, a meeting notice, a fact sheet, and a copy of the NOI were sent to approximately 1,600 agencies, organizations, and individuals on the RP/EIS mailing list.



NOTE:

[1] USFWS and NOAA are the lead federal agencies for preparation of the RP/EIS. Cooperating agencies are Ecology (lead state agency), Muckleshoot Indian Tribe, Puyallup Tribe of Indians, Corps, and EPA.

Figure 1.4-1. NEPA flow chart for Commencement Bay RP/EIS. Completed steps are shaded.

Based on meeting sign-in sheets, 42 members of the public and agency representatives attended the two informal scoping meetings held on September 21, 1994. The public raised comments and questions that assisted the Trustees in scoping the RP/EIS. Seven evaluation forms indicated that the meetings were generally informative; the informal format was appreciated. See the Scoping Summary Document (USFWS and NOAA, 1995) for a more thorough discussion on scoping comments. Additional comments were received from the U.S. EPA in a letter dated December 21, 1994. These comments addressed a wide range of topics, including NEPA compliance issues, resource issues, indirect effects, monitoring, and mitigation. Comments applicable to a programmatic EIS are addressed in this RP/EIS.

An additional advanced scoping workshop was held on December 6, 1995, at the Transmission conference room at City of Tacoma's Central Wastewater Treatment Facility. In preparation, a meeting notice was sent out to the revised RP/EIS mailing list (approximately 250 agencies, organizations and individuals) three weeks in advance of the meeting. The purpose of the meeting was to provide the public an opportunity to review and comment on an advanced copy of the draft RP/EIS, which was used as a subsequent scoping document. A memorandum that provides an overview of the meeting is included in Appendix D of Volume I of the RP/EIS.

Written comments on the preliminary draft document were also solicited. The majority of both oral and written comments on the preliminary copy of the draft RP/EIS focused around three major issues. They included the need to incorporate geographic focus areas for restoration activities, an improved evaluation of land use and shoreline consistency, and a better description of the guiding NRDA regulations and identification of the proposed injured resources. As a result of public comment during the advanced scoping phase, the preliminary Draft RP/EIS was extensively revised.

1.5.3 Sources and Categories of Comments

There were four sources of public comments and questions on the Commencement Bay RP/EIS, including written comments submitted to the Corps, oral comments presented at the September 21, 1994 informal scoping meeting, and the transcript of oral comments presented at the October 5, 1994 formal scoping meeting and December 6, 1995 workshop. A list of the names, organizations, written comments, and addresses of the 42 meeting attendees at the informal scoping meetings and a transcript of the formal public hearing are provided in the meeting summary in the Scoping Document (USFWS and NOAA, 1995).

Comments and questions were grouped into the following major categories:

1. Regulations, including NEPA, CERCLA, and SEPA.
2. Purpose and Scope of the RP/EIS.
3. Alternatives to be considered in the RP/EIS.
4. Relationship of the RP/EIS to other restoration activities.
5. Relationship of the RP/EIS to other plans.

The purpose of Scoping is to determine the scope and the significant issues to be analyzed in depth in the RP/EIS and to identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review. All issues raised by the public are addressed in the RP/EIS.

Significant comments or issues on the RP/EIS are presented below.

Comments	**Where this comment is addressed:**
1. The purpose and scope of the EIS.	Section 1.0 Purpose and Need
2. NEPA and SEPA regulations which control the preparation of an EIS.	last portion of Section 1.1 and Figure 1-1-2. of the RP/EIS
3. CERCLA regulations which mandate habitat restoration using damages received from PRPs; relationship of CB/NRDA process and restoration planning.	second paragraph of Section 1.1 of the RP/EIS
4. The RP/EIS compatibility with local plans and ordinances.	Sections 2.12, 4.4.1 and 4.5 in RP/EIS, Section 3.13 in the Conceptual Restoration Plan (Volume II)
5. The use of the results of other environmental restoration/planning studies conducted in the Commencement Bay watershed.	Sections 2.5.1.1 and 2.9.1.2 of the RP/EIS, Section 3.13 in the Conceptual Restoration Plan (Volume II)
6. Integration of the RP/EIS with other restoration, mitigation, and development actions within the Bay.	Section 5 of the RP/EIS and Section 3.13 in the Conceptual Restoration Plan (Volume II)

Comments	Where this comment is addressed:
7. Identification of injured resources and/or services.	Phase 1 of the Damage Assessment identified key resources. These key resources are listed in Section 2.3 of the RP/EIS
8. Identification and analysis of alternative restoration approaches and their underlying ecological principles.	Alternatives evaluation in Section 3.0 of the RP/EIS
9. Allocation of priorities and levels of effort.	Contained with each of the decision matrices for the alternatives (reference table 3.3-2 for example)
10. Selection of a preferred restoration alternative.	Section 4.4.5 of the RP/EIS
11. Relationship of the programmatic EIS to subsequent environmental documents anticipated for project-specific restoration.	Section 1.1 of the RP/EIS
12. Criteria to be used to rank and prioritize restoration project sites.	Decision matrixes for each alternative in Section 3.3 (reference table 3.3-2 for example)of the RP/EIS, Section 3 of the Conceptual Restoration Plan (Volume II)
13. Determination of future project implementation guidelines, stewardship options, impacts evaluation, public education opportunities, and monitoring and performance standards.	Conceptual Restoration Plan (Volume II)
14. Development of an adaptive management process.	Section 4.7 of the Conceptual Restoration Plan (Volume II)
15. Provision of opportunities for public access.	Contained within the decision matrices for each alternative, Section 3.3
16. Planning of project-specific restoration.	Section 3.0 of the Conceptual Restoration Plan (Volume II)

Additional issues identified during advanced scoping.

Comments:	Where this comment is addressed:
1. Improved evaluation of land use and shoreline consistency	Sections 4.0 and 5.0 of the RP/EIS
2. A better description of the guiding NRDA regulations and identification of the proposed injured resources.	Section 1.1, 2.3 and 5.0 of the RP/EIS
3. Geographic focus areas for restoration activities	Section 2.4 of the Restoration Plan in Volume II

2.0 AFFECTED ENVIRONMENT

2.1 Introduction

This section describes the existing environmental setting of the primary and expanded study areas, and identifies environmental resources or issues that could be affected by the Restoration Plan for injured natural resources and services. This discussion of the existing environmental setting is for purposes of compliance with NEPA. This section does not describe the baseline conditions pursuant to CERCLA. The primary and expanded study areas cover approximately 1,000 square miles (Figures 1.2-1 and 1.2-2) and extend over portions of Pierce and King counties. The combined study area includes Commencement Bay, the drainage basins of the Puyallup-White Rivers, and the coastal areas adjacent to the Bay.

2.1.1 Location of the study areas

The primary study area is within, or adjacent to, the environs of Commencement Bay, an estuarine bay of approximately 5,700 acres (8.9 square miles) at the southern end of Puget Sound. The primary study area includes lands and waters adjacent to the Tacoma shoreline and the Puyallup River, extending inland to State Route 161 (Figure 1.2-1). This includes Wapato, Hylebos, Puget, Clear/Swan and Clark's Creeks. The marine boundary of the site is the shoreline, intertidal areas, and bottom sediments of the nearshore area of Commencement Bay, subtidal areas, and the various waterways (Figure 1.2-1). The Port of Tacoma and its associated industrial areas occupy the Puyallup River delta at the east end of the Bay. Most of the upland inland area is densely urbanized with extensive industrial, commercial, and mixed use development. A portion of Commencement Bay is designated as a Superfund site, the Commencement Bay Nearshore/Tideflats (CB/NT) site, and is on the National Priorities List (EPA, 1989). The primary areas of contamination for the Commencement Bay Nearshore/Tideflats Superfund Site are located along the Commencement Bay shoreline (See Figure 2.9-2).

The expanded study area for the RP/EIS includes approximately 600,000 acres (1,000 square miles) of the Puyallup River basin (Figure 1.2-2). It is comprised of Commencement Bay and its basin, including the main tributaries (the Puyallup, Carbon, and White Rivers) and the coastal areas adjacent to the Bay (southern Vashon and Maury Islands and Dumas Bay). This area has important ecological connections with injured natural resources (particularly migratory species) that use Commencement Bay.

2.2 Habitat Types: Functions, Distribution and Conditions

2.2.1 Introduction

The following section discusses the existing biological resources of the primary and expanded study areas, and the functions and the potential restoration values of specific types of estuarine and riverine habitats. Additionally, the species that use these habitats, and

species/habitat linkages are provided in the following sections. A review of historic habitat types and conditions, based on the literature, maps, and photographs collected from 1850 to 1991, is included in Appendix C. This historical information will assist the restoration process by providing partial guidance as to what types of habitat may be appropriate for restoration in various locations throughout the primary study area. This appendix also discusses estimated habitat loss in Commencement Bay, corresponding effects on biological resources, and stresses and disturbances which have resulted in habitat loss and which may influence successful restoration of injured natural resources and services in the primary and expanded study areas.

2.2.2 Habitat types and functions

Maps showing the locations of existing major generalized habitat types (such as open water, estuarine, palustrine, etc.) and distribution within the primary and expanded study areas are provided in Figures 2.2-1 and 2.2-2. Within these major habitat types in the primary and/or expanded study areas, specific habitat units of relevance to this restoration process are shown in Table 2.2-1 (USFWS and NOAA, 1995).

Table 2.2-1. Major existing habitat types in the primary and expanded study areas.

Habitat	**General Location or elevations relative to NOAA zero sea level datum**
deep subtidal	-30 feet to -60 feet, marine, brackish
vegetated shallows	-30 feet to +5 feet, marine, brackish
mudflat/sandflat/gravel-cobble	-14 feet to +15 feet, marine, brackish
emergent marsh	marine, brackish, freshwater
riverine	rivers and streams
riparian	rivers and stream corridors

The Commencement Bay Cumulative Impact Study (Corps et al., 1993) identified "special aquatic sites" in the primary study area: mudflats, vegetated shallows, and wetlands (Figure 2.2-3). Although, as a result of development, very little of the original nearshore "special aquatic sites" remain in Commencement Bay, the existing mudflats, vegetated shallows, and wetlands support numerous fish, invertebrates, birds, and mammals. In addition to these estuarine "special aquatic sites", riverine and palustrine habitats in the primary study area

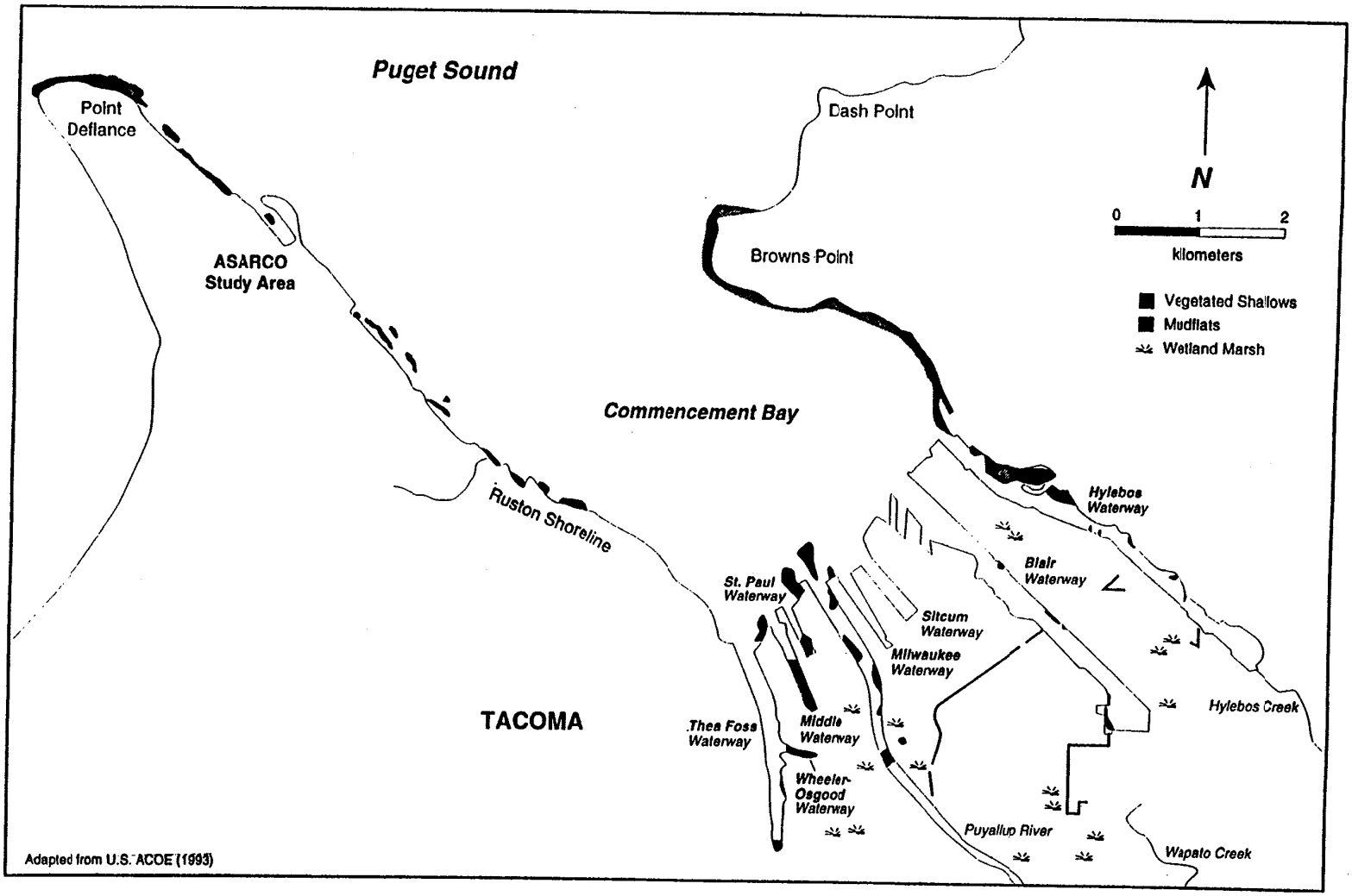


Figure 2.2-3. Special aquatic sites in 1988.

also directly or indirectly support many of the injured species. Furthermore, estuarine, palustrine and riverine habitats in the primary study area, and riverine and palustrine habitats in the expanded study area offer opportunities for restoration. Mudflats are typically exposed, unvegetated habitats that occur on broad, flat intertidal shores that are inundated at least once per day. Ecological functions provided by mudflats include nursery and feeding habitat for invertebrates and fish (such as juvenile salmon), and feeding and resting habitat for birds and mammals (Corps et al., 1993).

Eelgrass and/or attached macroalgae comprise the dominant vegetation in the vegetated nearshore habitats, which typically are permanently inundated but are exposed during extremely low tides. Eelgrass beds are often referred to as "nursery areas," because of their critical role in providing food sources and shelter for juveniles of many fish and macroinvertebrate species. Large numbers of invertebrates, birds, and juvenile salmon typically use eelgrass areas.

Riparian corridors are the vegetated stream and river banks that provide direct and indirect support to a variety of fishes, macroinvertebrates, birds, and mammals. The riverine habitat provides important spawning, rearing, overwintering and migratory habitat for a variety of anadromous and resident fish. The riverine habitat also provides cover and nesting habitat for a variety of resident and migratory birds, and cover, rearing and movement habitat for small mammals. Saltwater transition zones in rivers are an extremely important zone for juvenile salmonids during the critical smoltification process. During this process, juvenile salmonids undergo behavioral, physiological and morphological changes to prepare for oceanic life. During this transition period and subsequently during residence in the more saline portions of estuaries, juvenile salmon, particularly chum and underyearling chinook, gain weight.

Deep subtidal habitat is the subtidal zone between -30 ft and -60 ft MLLW. In Commencement Bay, this habitat type is comprised primarily of mud, with an overlying water column used by mammals, fish and birds. This habitat is critical for marine mammals, and also provides support for numerous fishes, macroinvertebrates, and birds not typically found in the other habitat types.

Each of these habitat types described above should support a predictable species assemblage based upon the Estuarine Habitat Assessment Protocol (EHAP) as described in Appendix D. The species listed in Appendix D, Tables D-1 to D-8 are known to be dependent on the particular habitat with which they are associated. The list of species in each table in Appendix D is representative, rather than inclusive, and more detailed information on the most common species currently found in the primary and expanded study areas is provided in the Commencement Bay Cumulative Impact Study (Corps et al., 1993). However, the feeding mode, reproductive habitats, and behavior of species that are not listed should be represented by at least one sympatric species on one or more of the lists.

2.2.3 Overview of existing habitats within the study areas

Throughout the Basin, previous development actions have fragmented the landscape. This fragmentation is particularly pronounced within the primary study area. The remaining viable estuarine habitats are often separated by altered shorelines or industrial development; migration routes into off-channel habitats are often blocked, preventing two way transfer of energy or individuals of species; and transition zones between habitat types are often lacking.

It is important to note that many of these remaining habitats in Commencement Bay, despite physical modification, support some or all of the life stage requirements for the natural resources of Commencement Bay that have been injured as a result of hazardous substances or oil. However, chemical contamination has reduced the natural resources value of much of the remaining habitat, original or not.

2.2.3.1 Primary study area

Distribution of existing habitat types is presented in Figures 2.2-1 and 2.2-2. Of the original mudflat habitat present in 1877, only 187 acres remained in 1988, as a result of various humans actions such as dredging, filling and conversion (Figure 2.2-3). The majority of the mudflats are located in the upper half of the Hylebos Waterway, within the Puyallup River, near the mouth of the Puyallup, and along the Ruston-Point Defiance shoreline. High densities of juvenile salmon have been observed in these areas (Duker et al., 1983). Though the distribution of birds is variable, the presence of intertidal herbivorous birds, such as geese and dabbling ducks, correlates well with the distribution of mudflats (Commencement Bay Natural Resource Trustees, 1995). Furthermore, numerous shorebirds, such as sandpipers, dunlins and dowitchers, use the mudflats to rest and feed upon invertebrates.

At most, an estimated 90 acres of subtidal and intertidal vegetated shallows remained in 1988. Only 57 acres, or approximately 1 percent, of the original tidal marsh remained in the primary study area in 1988. Eelgrass and/or attached macroalgae comprise the dominant vegetation in the vegetated nearshore shallow. The majority of the vegetated shallows are located from the mouth of the Hylebos Waterway towards Brown's Point, and in patches along the Ruston-Point Defiance shoreline (Figure 2.2-3). High densities of juvenile salmon have been observed in these areas (Duker et al., 1989). This dramatic habitat loss resulted from intentional filling for port development, flood control, and agricultural use. Much of the 57 acres of remaining marsh is probably not original habitat, and could have formed after the original habitat was lost (Shapiro and Associates, 1992). Within the primary study area, aside from attached macrophytes the major wetland types are tidally influenced low and high saltmarshes and freshwater marshes (Shapiro and Associates, 1992).

The Puyallup River saltwater transition zone located in the primary study area, is an extremely important zone for juvenile salmonids during the critical smoltification process, as described above in Section 2.2.2.

Upstream from its confluence with Commencement Bay, the mainstem Puyallup extends approximately 8.3 miles to SR-161 (the primary study area boundary) and provides riverine and limited riparian habitat. Throughout this area, the river is extensively channelized and confined by large flood control dikes that have isolated or reduced connectivity with old oxbows, off-channel habitat, wetlands and small tributary streams. Many of these habitats are suitable for a variety of restoration actions. Clark's (3.7 miles long) and Clear (3.8 miles long) Creeks are two important tributaries in this reach (WDF, 1975). The density of land use decreases moving upstream from the mouth of the Puyallup River towards the boundary of the primary study area, as it changes to agriculture, office park, light industry and residential uses.

The independent drainage basins of Hylebos (9.0 miles mainstem) and Wapato (13.8 miles mainstem) Creeks also contain riparian and riverine habitat areas suitable for anadromous and resident fish, birds and small mammals. Hylebos Creek discharges into the base of the Hylebos Waterway. Wapato Creek discharges to the Blair Waterway. Both waterways are utilized extensively for port and industrial activities. The heavy industrialization and port activities at the mouth, and growing urbanization towards the headwaters, limit potential for fish production. However, the flows from these streams are important to the specific ecological functions of the estuarine and marine environments near the confluence with salt water (WDF, 1975).

Habitat changes in the primary study area reflect the development of railroads, shipping, logging, agriculture, and other industries. Significant habitat loss resulted from dredging and relocating the Puyallup River, from construction of waterways for the purposes of navigation and commerce, from steepening and hardening formerly sloping and/or soft shorelines with a variety of materials, and from the development of the Port of Tacoma and other developments. Marsh areas were filled for residences, barns, and roads. Other habitat losses are the result of contaminated water and sediment from industrial and domestic discharges. Dredging, diking, and channelizing of the Puyallup River likely altered the suitability of habitats for wetland and aquatic plants, benthic invertebrates, demersal fish, and the animals that prey on these organisms.

Physical loss of intertidal mudflat and tidal marsh habitats, hardening and steepening of the shoreline and shallow water habitats, and other habitat alterations in the Bay have diminished populations of many plants and animals, reduced benthic production, and reduced geographical distributions of many species of anadromous salmonids, demersal fish, clams, crabs, and shrimp.

2.2.3.2 Expanded study area

The expanded study area includes approximately 600,000 acres (1,000 square miles) of the Puyallup River basin. This area has important ecological connections with injured natural resources (particularly migratory species) that use Commencement Bay. The Puyallup River system is comprised of a single mainstem river with numerous tributaries, the largest being the Carbon (230 square mile subbasin) and White Rivers (468 square mile subbasin). The

Puyallup River basin, including tributaries, drains an area of approximately 1,000 square miles of mountains and lowlands. The basin contains over 700 miles of streams and rivers (WDF, 1975) incorporating a range of riparian, palustrine and riverine habitat. The Puyallup-White River basin was one of ten watersheds west of the Cascade Mountains that was recently identified as a "preliminary priority watershed" for fish and wildlife restoration (WDFW and WDNR, 1995). The list of priority watersheds represents the first step by state agencies to determine species and habitats that benefit most from limited state funds available for restoration or conservation activities.

Within the expanded study area, pockets of dense development occur, but overall, the existing land use pressures are less than in the primary study area. There are also freshwater wetlands which have or could support some injured species. Within the expanded study area, readily identifiable stresses to natural resources include deterioration of water quality; channelizing, diking, gravel mining and other physical modifications to the channel and riparian zones of the various drainage systems; and water diversions for out-of-river uses. Vegetation management practices, industrial, agricultural, and residential development, and logging, as well as other stresses, have resulted in losses of riparian corridors and forested uplands in the expanded study area. Such losses are ongoing.

In the expanded study area, the probable effects of lost riverine-riparian habitat on fish and macroinvertebrates include loss of shade, increased water temperatures, reductions in food resources available for fish, reduction in terrestrial carbon inputs into the system, reduced primary productivity and nutrient cycling, loss of woody debris, and decreased structural diversity. This also results in increased erosion, bank failures, sedimentation, and flooding. The impacts of such alterations upon some injured species such as salmon may have rendered them more susceptible to injury in the estuary.

2.3 Key Resources and Services

Key natural resources in Commencement Bay, as identified by the Natural Resource Trustees, include salmonids, flatfish, invertebrates and birds (Commencement Bay Natural Resource Trustees, 1995). Table 2-3.1 presents a summary of key resource categories, and applicable biological and abiotic resources in Commencement Bay (Commencement Bay Natural Resource Trustees, 1995).

Table 2.3-1 Summary of Key Resources.

Key Resource Category	Biological	Abiotic
Economically or recreationally harvested resource including Tribal harvest	Salmonids (chinook, coho, chum, and pink salmon, and steelhead trout) Flatfish (English and rock sole) Epibenthic macroinvertebrates (dock shrimp, red rock crab, and Dungeness crab)	
Important links in supporting the ecosystem	Benthic infaunal invertebrates (polychaetes and bivalves) Epibenthic invertebrates (amphipods) Benthic macroinvertebrates (decapods and echinoderms)	Surface water and sediment
Important elements of non-consumptive uses	Birds (peregrine falcon, bald eagle and great blue heron)	
Resources that are endangered or threatened	Birds (peregrine falcon, bald eagle, and marbled murrelet)	

Some of the major services provided by natural resources within the Commencement Bay areas, as identified by the Trustees, include recreational, consumptive uses, non-consumptive uses, passive uses and Tribal services.

2.4 Injuries to Natural Resources and Services

Key natural resources in the study area that have been injured by the release of hazardous substances or the discharge of oil include salmonids, flatfish, benthic infauna, epibenthic invertebrates, larger invertebrates, birds, sediments and surface water (Commencement Bay Natural Resource Trustees, 1995). The Trustees also identified the major service types provided by natural resources within the Commencement Bay areas that may have been

injured, including recreational services, non-consumptive uses, passive uses and Tribal services. A detailed preliminary description of injuries to natural resources and services is found in the Commencement Bay Phase 1 Damage Assessment report (Commencement Bay Natural Resource Trustees, 1995). It is not the purpose of this section to repeat the Phase 1 report but to highlight issues pertinent to the affected environment.

Industrial, commercial, municipal and other activities in Commencement Bay have resulted in the release of hazardous substances and discharges of oil into the estuarine environment, either directly by disposal and discharge to land, water and the atmosphere, or indirectly as nonpoint sources of pollution (Shapiro and Associates, 1992). Contaminants were released into the Waterways and Commencement Bay as a result of numerous operations, including pulp and lumber, shipbuilding and marinas, chlorine production and chemical manufacturing, oil refining, aluminum smelting, railroad operations, urban runoff, municipal wastewater, and automotive repair services (Commencement Bay Natural Resource Trustees, 1995).

The EPA (1989) identified eleven high priority areas, subsequently consolidated into nine areas, and later reduced to eight. The eight problem areas are considered high-priority problem areas because of substantial sediment contamination (see Figure 2.9-1). The Ruston-Point Defiance operable unit in the vicinity of the ASARCO smelter site was identified as an additional problem area, bringing the total to nine. Several of the Commencement Bay waterways contain organic compounds such as polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), chlorinated butadienes, dibenzofurans, phthalates, hexachlorobenzene, and chlorinated pesticides. Several of the waterways also contain metals, such as arsenic, copper, lead, mercury, and zinc (Commencement Bay Natural Resource Trustees, 1995). Contamination of the water and sediments directly affects organisms and populations such as fish, benthic, and epibenthic invertebrates that live in contact with such waters and sediments. Effects can range from chronic disorders and death, to reduced population survivability. These contaminants are ingested or taken up directly from the sediment or water, or are ingested through the food web where bioaccumulation may occur. Contaminant concentrations in affected regions of Commencement Bay are found at levels that have adversely affected the biological community (Ecology, 1995) in the manner described below.

The nine areas of high sediment contamination (see Fig. 2.9-1 for locations and names) have much reduced habitat value. Reductions in benthic species diversity and abundance have been documented for many contamination "hotspots" in Commencement Bay (Becker et al., 1990; Commencement Bay Natural Resource Trustees, 1995). Metals, PCBs, PAHs, dibenzofurans, chlorinated pesticides, and phthalates can cause acute, chronic lethal, and chronic sublethal effects in benthic and epibenthic organisms, demersal fish, and other organisms living in contact with the sediment (Shapiro and Associates, 1992). Benthic and macroinvertebrate assemblages in Commencement Bay have reduced abundances, number of taxa, and major taxa abundance, as well as increased adverse responses which are attributed to both acute and chronic exposures to toxic chemicals. McCain et al. (1990) demonstrated in the Duwamish River, a similarly contaminated urban estuary, that

outmigrating juvenile salmon bioaccumulate substantial levels of toxic chemicals. Furthermore, a study of the Puyallup River where it enters Commencement Bay indicated chemical exposure to juvenile chinook salmon as they moved through the estuary with exposure sufficient to elicit biological responses believed to be early steps in the process of chemical carcinogenesis and other toxic effects (Varanasi et al., 1993). Growth and survival of juvenile salmon from the Duwamish River, was significantly lower than that of fish from the Nisqually estuary or from the hatcheries, when held in the laboratory for up to 80 days (Varanasi et al., 1993). Thus, McCain et al. (1990) and Varanasi et al. (1993) clearly demonstrated that, during residency in urban estuaries, juvenile chinook salmon bioaccumulate substantial levels of toxic chemicals and that diet represents an important route of exposure. Contaminated sediments from industrial activities in the Bay have led to histopathological disorders in flatfish and elevated contaminant levels in shellfish.

Of the non-anadromous fish species, flatfish are the most susceptible to histopathological disorders, because they spend their entire life cycle in direct contact with the sediment, where they are at risk of bioaccumulating sediment-associated chemical contaminants (Malins et al., 1987; Malins et al., 1988). In addition, their primary food resources also live in contact with surface sediments and some contaminants can move up the food chain as organisms associated with contaminated sediments are consumed. This trophic transfer process is known as biomagnification, the tendency of some chemicals to increase to higher concentrations through dietary accumulation in the higher levels in the food web.

Some bird species have experienced biomagnification of contaminants by feeding on contaminated assemblages of aquatic plants and animals (Commencement Bay Natural Resource Trustees, 1995).

Individuals of all key biological resources in Commencement Bay (i.e., salmonids, flatfish, benthic invertebrates and birds) have accumulated a variety of contaminants in their tissues (Commencement Bay Natural Resource Trustees, 1995). A conceptual food web model of the interaction between key natural resources and contaminated sediment is presented in Figure 2.4-1.

The Tacoma-Pierce County Health Department has posted advisories restricting the consumption of fish and shellfish because of high concentrations of some trace elements and organic compounds in fish and crab from Commencement Bay (Washington State Department of Health, 1992; Commencement Bay Natural Resource Trustees, 1995). Thus, chemical contamination has reduced the value of much of the remaining habitat, whether original or not, that provides services to people.

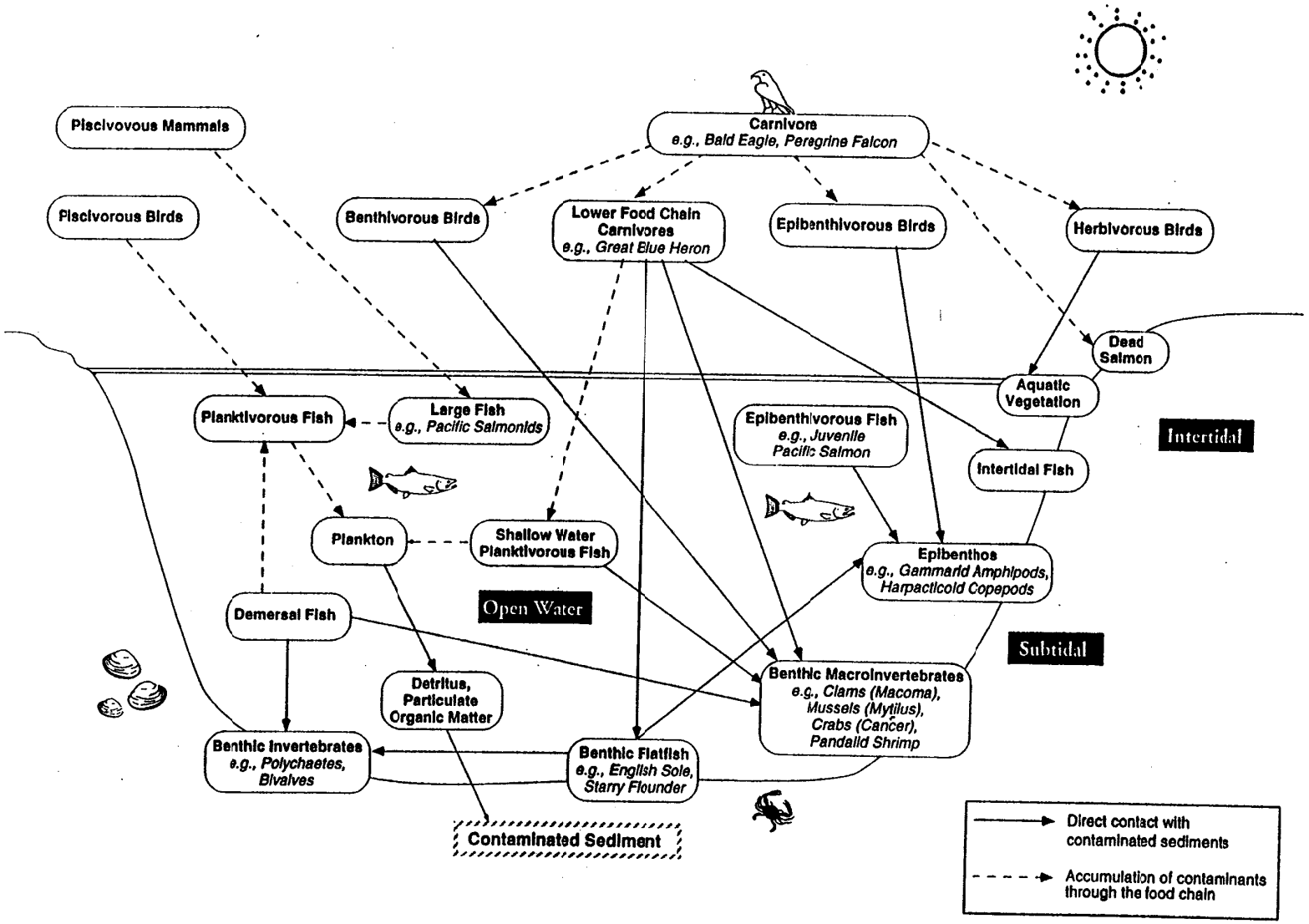


Figure 2.4-1. Conceptual food web model of Commencement Bay.

2.5 Fish and Wildlife Resources

Commencement Bay and its basin provide habitat for a variety of fish, birds, mammals, amphibians and reptiles. Some species are permanent residents of the Bay or basin, and others are migratory, though the Bay may be essential for a species' critical life history stage.

No single detailed bird study of the Bay or Basin has been performed, however a detailed review of existing studies has been compiled into Appendix A of the EIS. Less information is available regarding mammals, amphibians and reptiles that may use the Bay and Basin. However, the Phase 1 Damage Assessment Report compiled a list of mammals, reptiles and amphibians that may occur in the primary study area (Commencement Bay Natural Resource Trustees, 1995). The reader is referred to that document for more detailed information. However, injured or important fish and wildlife species are discussed in the following sections.

2.5.1 Fish

2.5.1.1 Anadromous species

Anadromous salmonid species presently found in the primary and expanded study areas include chum, pink, coho, sockeye and chinook salmon, steelhead, and cutthroat trout (Shapiro and Associates, 1992) as well as bull trout and Dolly Varden (Goetz, 1995, personal communication). The current distribution of salmonids in the Puyallup River basin is affected by dams, weirs, culverts, screens, falls, and other artificial or natural features which may hinder or obstruct their passage (see Appendix D, Figures D-1 to D-4) as well as by changes to the hydraulic regime and other habitat modifications. Salmonid species within the study area are of great cultural, commercial and recreational importance. The Puyallup Tribe and Muckleshoot Tribe have active fisheries restoration, enhancement and management programs in the Puyallup River basin.

Although some wild salmon stocks persist, the dominant salmonid populations in the system are hatchery-reared coho, fall chinook, and chum salmon from the Muckleshoot Tribe's White River Hatchery, the Puyallup Tribe Hatchery at Clark's Creek and the Washington Department of Fisheries and Wildlife hatchery at Voight Creek. Documented juvenile use in Commencement Bay occurs from March to July, with peak migrations of juvenile salmon through Commencement Bay from late March to mid-June (Duker et al., 1983). However, based upon observations from the Duwamish River, significant juvenile use is expected to occur from March through at least August. Duker et al. (1989) suggest coho salmon exit Commencement Bay shortly after entry, while chinook and chum spend a much greater time in the Bay. Chinook salmon take approximately 10 to 12 days to move from the mouth of the Puyallup River to the Ruston Way and Brown's Point shorelines, by which time greater numbers have moved further offshore, presumably as a result of increased size. High densities of juvenile salmon have been observed in, near and on the mudflats and vegetated shallows (Duker et al., 1983). Additionally, large numbers of hatchery and naturally spawned juvenile salmon use the mouths of the waterways and to some extent, the

waterways themselves. Adult salmon generally migrate through the Bay from April through December. Adult steelhead trout migrate from late November to early January. Hatchery releases of juvenile salmonids (chinook, chum, pink, coho, steelhead) to the Puyallup River in 1992 are summarized in Table D-9, Appendix D.

The Washington State Salmon and Steelhead Stock Inventory report lists the White River spring chinook, the sole remaining spring chinook stock in south Puget Sound, as critical. A critical designation means the stock is experiencing production levels that are so low that permanent damage to the stock is likely or has already occurred. The spring chinook spawning population now depends largely on some degree of artificial production, such as the Muckleshoot White River Hatchery. In addition, Puyallup River coho are listed as depressed, exhibiting production levels below those expected based on available habitat and natural variations in survival rates, but above the level where permanent damage to the stock is likely (Washington State Department of Fish and Wildlife and Western Treaty Tribes, 1994).

Salmon travel through the Commencement Bay estuary both as juveniles during their seaward migration, and as adults during their spawning migration to their natal streams. These adult and juvenile migrations expose salmon to contaminants within the primary study area. During their outmigration, juvenile salmon of some species spend only a short, but critical, period using many different nearshore habitats, depending on their size and age. All three of the special aquatic sites (mudflats, vegetated shallows, and wetlands) provide critical food resources for juvenile salmon that depend on the detritus-based food web in these habitats. These areas are important for gaining the necessary size for moving further offshore. In addition, juvenile salmon depend on these types of estuarine habitats for seawater acclimation during smoltification (a time of great physiological stress), migration guidance, and refuge from predators (Simenstad et al., 1993; Shreffler et al., 1992). Though juvenile salmon food habits are also quite variable among species and habitats, common food resources for salmon fry include copepods, amphipods, decapod larvae, euphasiids, larval fish, mysids and cumaceans in nearshore habitats, and include chironomids in salt marshes. Many of these food resource items come into contact with contaminated sediments and serve as a pathway for contamination.

The relative preference of juveniles of various salmon species for nearshore estuarine residence versus pelagic residence, has implications for exposure to hazardous materials and subsequent injury. For example, chum and chinook fry may initially spend time feeding nearshore on organisms in the contaminated sediment, while the larger coho smolts may be further offshore in the Bay, where their exposure to contaminated sediment is potentially less. Residence times of juvenile salmon are variable both among species and habitats. In Commencement Bay, residence times range from up to eight weeks for chum and coho to more than nine weeks for chinook, and up to 16 weeks for pink salmon (Shapiro and Associates, 1992). Further upstream in the lower Puyallup River, residence times of one to nine days for juvenile chum and up to 43 days for juvenile chinook in the restored Gog-le-hi-te wetland have been documented (Shreffler et al. 1990). Residence times in various types of estuarine habitats are dependent, in part, on the availability and density of

preferred food resource organisms. Thus, residence times in contaminated areas will also contribute to potential exposure.

2.5.1.2 Non-anadromous species

Fifty-nine species of non-anadromous marine fish possibly occurred in the primary study area prior to 1877 (Shapiro and Associates, 1992). If present today, many of these species would spend their entire life cycle within the study area. In 1993, Eaton and Dinnel (1993) sampled marine fishes and macroinvertebrates at Blair and Hylebos Waterways. Forty five species of fish including the following were captured: flatfish (primarily English sole and rock sole), Pacific tomcod, bay gobies, snake pricklebacks, Pacific staghorn sculpins, and pygmy poachers.

Sand lance spawning occurs on beaches near the lighthouse at Brown's Point, near the lighthouse at Dash Point, and on a small pocket beach in southern Commencement Bay along Ruston Way (see Appendix D, Figure D-5). Surf smelt spawning has been documented on the beach near the Brown's Point lighthouse. Some fish such as starry flounder, C-O sole, and English sole tend to be found in the Waterways and along the Waterway mouths. Others, such as English sole, rock sole, and flathead sole tend be found along the Brown's Point and Ruston-Point Defiance shorelines (Commencement Bay Natural Resource Trustees, 1995).

Flatfish typically occupy flat, soft bottom habitats such as submerged mudflats. The prevalence of flatfish within the primary study area is explained, in part, by the availability of their preferred mudflat habitat throughout the Bay. The preferred food resources of flatfish are polychaete worms, bivalves, and gammarid amphipods (Shapiro and Associates, 1992).

2.5.2 Invertebrates

Benthic invertebrates are those organisms that live within bottom sediments (i.e., infauna), whereas epibenthic invertebrates are associated with the sediment surface interface with the water column. Benthic and epibenthic organisms are primarily detritivores and form an integral component of the detritus-based food web; a variety of fish and shorebirds depend on benthic and epibenthic and benthic food resources. In particular, the growth and survival of juvenile salmon is dependent on the quantity and quality of benthic and epibenthic food resources (Simenstad et al., 1993).

The three major invertebrate taxa found in Commencement Bay are polychaetes, bivalve molluscs, and crustaceans, all of which use both intertidal and subtidal habitats. A detailed list of invertebrate species in Commencement Bay can be found in Shapiro and Associates (1992). The following review is derived primarily from an analysis of changes in benthic and epibenthic invertebrate communities (Simenstad et al., 1993). Dominant benthic organisms in the Waterways and inner parts of the Bay area are the molluscs *Axinopsida serricata* and *Macoma carlottensis*, the polychaetes *Tharyx multifilis*, *Nepthys cornuta*, *Armandia brevis*, and

Chaetozone spp., and the ostracod crustacean *Euphilomedes carcharodonta*. Most of these species are considered pollution-tolerant and are often found in stressed communities. The most common epibenthic organisms in Commencement Bay intertidal and subtidal mudflats are the harpacticoid copepods *Harpacticus* spp., and *Tisbe* spp. and the cumacean *Cumella vulgaris*. Copepods serve as an important food source for juvenile salmon and other fish occurring in the area. Simenstad, et al. (1993) summarized the occurrence of dominant benthic and epibenthic taxa in selected waterways of the Bay from 1973 to 1984.

The dominant macrofauna species captured in subtidal mudflats in 1993 surveys by Eaton and Dinnel (1993) were purple shore crabs, coonstripe shrimp, and benthic sand shrimps. A few adult Dungeness crabs were caught in the Hylebos and Blair Waterways. No juvenile (0 to 2 years old) Dungeness crabs were caught, indicating that these waterways either do not provide habitat for young of this species, or that no juvenile settlement had recently taken place in the Commencement Bay area.

2.5.3 Wildlife

2.5.3.1 Birds

Based on field observations generated by multiple observers or organizations, 185 species of resident and migratory birds have been observed in the primary and expanded study areas. At the restored 10 acre Gog-le-hi-te wetland, 112 bird species were observed between 1986 and 1990 (Thom et al., 1991). The results of a 1995 review of bird use of the primary and expanded study areas is provided in Appendix A. Though the distribution of birds is variable, intertidal herbivorous and predatory birds are found on or near mudflats. Open water piscivorous fish-eating birds are found within the waterways, the Puyallup River and the nearshore areas, as well as offshore. Benthivorous ducks are located within the waterways and near waterway mouths, the Puyallup River, the Ruston shoreline, and the Brown's Point shoreline (Commencement Bay Natural Resource Trustees, 1995). Numerous shorebirds such as sandpipers, dunlins and dowitchers use the mudflats to rest and feed upon invertebrates.

Although the diversity of avian species does not appear to have decreased in the Bay because of habitat loss, a significant loss of abundance has occurred for many species. This is based on a comparison to substantially greater populations of waterfowl in less disturbed estuarine systems such as the Nisqually, Nooksack, Skagit, Snohomish, and Stillaguamish River deltas. In addition, urbanization has contributed to shifts in species composition from predominately waterfowl to less wetland-dependent passerines and song birds, which inhabit the urban and suburban areas. However, contaminated water, sediments and food resources have likely resulted in changes in food habits and available food resources for many species of birds (see Appendix A). Some birds, such as western grebes, great blue herons, pigeon guillemots, and glaucous-winged gulls, have bioaccumulated contaminants through the food web by feeding on contaminated assemblages of aquatic plants and animals (Block, 1992; Giesy, 1995).

The only endangered species in the Bay is the peregrine falcon. Threatened species include bald eagles and marbled murrelets. The harlequin duck, which is a winter visitor to Brown's Point, is a candidate species. Washington State priority species include band-tailed pigeons, great blue herons, osprey, purple martins, Vaux's swifts, western bluebirds, and yellow-billed cuckoos. (See Appendix B). Appendix A provides an assessment of birds within the primary and expanded study areas. Avian use of different habitat types is summarized in Table 2-5-1.

2.5.3.2 Mammals

Thirty five upland and seven marine mammal species are likely to be present in the primary and expanded study areas (Commencement Bay Natural Resource Trustees, 1995) (Appendix D: Table D-10). Little information is available on the historical or present distribution and abundance of these species. Nearshore habitats in Pacific Northwest estuaries are known to support the following common mammals, which reside and feed in marsh or mudflat communities: raccoons, river otters, mice, rats, skunks, shrews, muskrats, and nutria (Simenstad, 1983).

Table 2.5-1. Summary of Applicable Avian Habitat Types and Functions in the primary and expanded study areas. See Appendix A for more detail.

Habitat Type	Functions
Mudflat	Provide feeding and resting habitat for waterfowl and shorebirds. Sandpipers, dunlins, dowitchers, and bufflehead ducks typically can be found in this habitat type.
Vegetated shallows	Eelgrass and macroalgae beds support a diverse assemblage of marine invertebrates that are consumed by shorebirds, scaup, coots, scoters, and herons. Eelgrass is the preferred food of black brant and is also eaten by Canada geese, widgeons, scoters, canvasback ducks, and coots (Phillips, 1984).
Emergent marshes	In comparison to other habitat types, emergent marshes in the Bay area support the highest diversity of bird species. Emergent vegetation provides cover, nesting sites, and food for a wide variety of ducks, shorebirds, songbirds, and raptors (Appendix A).
Intertidal gravel-cobble	Formed along beaches and bars in exposed regions of the Bay, are frequently used by gulls, grebes, and sandpipers.

Habitat Type	Functions
Open water	In Commencement Bay these primarily provide feeding and resting habitat for waterfowl. Birds commonly associated with this habitat type are piscivorous waterfowl, osprey, and eagles.
Riparian	Offer cover and nesting habitat along the banks of the Puyallup River and its tributaries, Wapato Creek, and Hylebos Creek. Waterfowl, songbirds, herons, and raptors depend on this habitat type.
Upland forested	Along Dumas Bay, the Hylebos Waterway, Ruston Way toward Point Defiance, and in small patches throughout the urban areas, provide niches for wrens, thrushes, vireos, warblers, sparrows, finches, and owls, as well as nesting sites for cavity-nesters, herons, and raptors.
Agricultural areas	Support sizable populations of gulls, Canada geese, robins, and ducks, particularly in the vicinity of Wapato Creek and Puyallup River oxbows.

Coyotes are present in many suburban areas and may also be found in the tideflats. Red foxes have been observed in marsh areas (e.g., Gog-le-hi-te wetland). Riparian species such as beaver, muskrat, and mink are present along the Puyallup River. In addition, bats (e.g., little brown myotis and long-legged myotis) are migratory visitors which may occur in the study area (Commencement Bay Natural Resource Trustees, 1995).

Harbor seals, California sea lions, killer whales, harbor porpoises, Dall porpoise, and gray whales have been observed in southern Puget Sound (Calambokidis et al., 1991). The closest seal pupping ground to the primary study area is on Gertrude Island, south of Tacoma Narrows, but it is not known whether seals pupping on Gertrude Island use the Bay (Commencement Bay Natural Resource Trustees, 1995). Small groups of Dall porpoise are seen year-round in south Puget Sound, and they could potentially breed in the south Sound (Angell and Balcomb, 1982).

It is reasonable to assume that reduction in available estuarine and riverine habitat has resulted in reduced abundances and distribution of some mammal populations, as well as reduction in available food resources and breeding areas. In addition some of the existing food sources have become contaminated due to the release of hazardous substances and the discharge of oil; additionally, bioaccumulation has been documented in the Bay (Commencement Bay Natural Resource Trustees, 1995).

2.6 Threatened and Endangered Species

This section discusses Federal threatened and endangered species and State sensitive species. The purpose of this section is to briefly summarize the status of threatened and endangered species within the primary and expanded study areas. The U.S. Fish and Wildlife Service, in a letter dated August 30, 1995 (Appendix B), provided a list of endangered, threatened and candidate species (see Section 2.6.3) that are known to occur or have the potential to occur either occasionally or periodically in the vicinity of the primary or expanded study area. The National Marine Fisheries Service, in a letter dated August 8, 1995 (Appendix B), provided a list of endangered, threatened, and candidate species that are known to occur or have the potential to occur either occasionally or periodically in the vicinity of the primary or expanded study area. The Washington Department of Ecology, in a letter dated September 5, 1995 (Appendix B), provided a list of state sensitive species, priority species and priority habitats. The distribution of State sensitive fish and birds in the Commencement Bay area is shown in Appendix B. The federal species are discussed in more detail in the sections below.

Federal threatened and endangered species within the study area are listed Table 2-6-1. A list of federal candidate species located within the combined primary and expanded study area is found in Appendix B. Changes to the candidate species list were published in the Federal Register on February 28, 1996 (Vol. 61 No. 40, 7596). Previous category one species are the only species now considered federal candidate species. These are the only candidate species discussed in Section 2.6.3.

Table 2.6-1. List of Federal threatened and endangered Species within the Primary and Expanded Study Areas.

Species	Status	Study Area
Peregrine falcon	Endangered	Primary
Bald eagle	Threatened	Primary/Expanded
Marbled Murrelet	Threatened	Primary/Expanded
Gray wolf	Endangered	Expanded
Grizzly bear	Threatened	Expanded
Northern spotted owl	Threatened	Expanded

2.6.1 Endangered species

Gray wolf (*Canis lupus*)

The wolf was listed as endangered throughout the lower 48 States, except Minnesota, in 1978. Gray wolves could potentially utilize the upper basin, including wilderness areas and Mt. Rainier National Park, as well as adjacent habitats. Key habitat components necessary for wolves include: year-round prey base of ungulates and alternative prey; suitable and secluded denning sites; and sufficient area.

Peregrine falcon (*Falco peregrinus*)

The Peregrine falcon was listed as endangered in 1970. This species nests throughout North America. It chooses remote cliff ledges for nesting sites. These sites may be used by successive generations of peregrine falcons (USFWS, 1982). Food sources of the Pacific Coast population are usually waterfowl, shorebirds, and small passerine birds. Peregrine falcons have nested on tall buildings in Tacoma, and may nest in other portions of the study areas.

2.6.2 Threatened species

Bald eagle (*Haliaeetus leucocephalus*)

Nesting and wintering populations in almost all recovery areas in Washington, including the West Cascade Mountains recovery zone, have reached levels that will allow delisting. However, habitat loss, degradation, and major disturbance factors continue to be serious problems that must be guarded against to assure population gains are not diminished (USFWS, 1986). Bald eagles are year-round residents in the vicinity of Commencement Bay as well as throughout the Basin. They occasionally nest at Point Defiance and Brown's Point. Bald eagles are adaptable, feeding on whatever is most expedient. In Commencement Bay, the most likely food resource items are gulls, waterfowl, and fish.

Marbled murrelet (*Brachyramphus marmoratus*)

This species was listed as threatened in California, Oregon, and Washington on October 1, 1992. Marbled murrelets are occasional visitors to marine waters of Commencement Bay. There are recordings of flyovers in the upper part of the Puyallup basin. The loss of suitable nesting habitat is thought to be the primary threat facing this species. It nests on large diameter (usually greater than 7 inches) upper branches of coniferous trees in older seral stage stands and forests from the marine coast and inland up to about 40 miles (Marshall, 1988; Hamer and Cummins, 1991). This marine bird spends the majority of its life on marine waters, where it forages for several small species of fish (Carter, 1984).

Northern spotted owl (*Strix occidentalis caurina*)

Northern spotted owl was listed as threatened throughout its range on July 23, 1990. It is listed as a State Endangered species in Washington. Primary habitat includes interior portions of older seral-stage closed canopy forests. Continued loss of, and decline in, quality of primary nesting, roosting, foraging, and dispersal habitat; along with isolation of subpopulations are the primary threats facing this species (USFWS, 1992).

Critical habitat was delineated on January 15, 1992 and includes portions of the upper basin. Designated critical habitat is restricted to the upper basin and is surrounded by Clearcreek and Norse Peak Wilderness areas and Mount Rainier National Park.

Grizzly bear (*Ursus arctos = u.a. horribilis*)

The grizzly bear was classified as a threatened species south of the Canadian border on September 1, 1975. Grizzly bears spend late fall through December denning. In spring they move to river bottoms, drainages, avalanche chutes and ungulate winter ranges to feed prior to moving back to higher elevations in the late spring. The greatest threats to grizzly bears are habitat modification or loss, and human-caused direct mortality (IGBC, 1987).

2.6.3 Candidate species

There is no federal requirement to assess impacts to candidate species. However, protection provided to candidate species now may preclude possible listing in the future. Candidate species are those "taxa" for which the USFWS has on file sufficient information to list them as threatened or endangered species, but issuance of the proposed rule is precluded (published in the Federal Register on February 28, 1996, Vol.61 No.40, 7597). As two federal agencies are co-lead for the RP/EIS, project-specific environmental guidelines will include an assessment of potential adverse impacts to candidate species. Candidate species potentially occurring in the study areas include bull trout and spotted frog, and are discussed below. The USFWS, Washington State Office now makes available a list of species of concern. Species of concern are those species for which the USFWS has information indicating possible appropriateness for listing but for which further information is still needed. The USFWS letter in Appendix B has been amended to reflect changes in candidate species. The two candidates are identified with a "C" and the other remaining species listed as candidates are being evaluated for inclusion as species of concern.

Bull trout (*Salvelinus confluentus*)

The bull trout is currently listed as warranted but precluded under the Endangered Species Act (ESA). "Warranted but precluded" means available biological evidence indicates that the extinction risk to a species is sufficient to warrant protecting it under the ESA, but that such action is precluded by the need to protect other species judged to be at greater risk. Historically bull trout were found in most major river systems in the Pacific Northwest. Within the past 30 years its distribution has become greatly reduced (Goetz, 1989). Current

assessments have documented bull trout in the Carbon, White and Greenwater Rivers and many drainages in the White River basin, including Huckleberry and Silver Springs Creeks (Goetz, 1995, personal communication).

Bull trout are a species of char that are well adapted for life in very cold water. Bull trout spawn during the fall in areas with abundant cold clean water, clean gravel and cobble substrate, and gentle stream slopes. Juvenile fish retain their affinity for the stream bottom, and are often found at or near the bottom. Bull trout may reside in close proximity to areas where they were spawned, migrate from small streams to larger streams and rivers, or migrate from streams to lakes, reservoirs or salt water, potentially exposing them to contaminants. They feed on terrestrial and aquatic insects, and consume other fishes as they increase in size.

Spotted frog (*Rana pretiosa*)

The spotted frog is listed as a Federal Candidate (C1) and as a State Candidate in Washington. The spotted frog is nearly always found in or near a perennial water body such as a spring, pond, lake or sluggish stream. It is most often associated with nonwoody wetland plant communities, composed of sedges, rushes and grasses (Leonard et al., 1993).

2.6.4 Marine mammals

The National Marine Fisheries Service, in a letter dated August 8, 1995, indicated that humpback whale (*Megaptera novaeangliae*), Stellar sea lion (*Eumetopias jubatus*) and leatherback sea turtle (*Dermochelys coriacea*) may occur in Puget Sound. The only species anticipated in the study areas is the Stellar sea lion.

Stellar sea lion

The Stellar sea lion is the largest member of the family Ottariidae. Stellar sea lions are opportunistic feeders and eat a wide variety of food resource items that change through season and locality. Food resources include Pacific hake, halibut, rockfish, skates, and squid. Though geographically widespread, most breeding takes place in Alaska (Everitt et al., 1979). No breeding occurs in Puget Sound (Everitt et al., 1979), and no hauling areas are located in mid- and south Puget Sound. Stellar sea lions are rarely found south of Admiralty Inlet, which is well north of the study area (Yates, 1988).

2.7 Geology and Soils

The following summary is based primarily on a review of the geologic history of the region in a report on the geology of the Port of Tacoma by Hart Crowser and Associates, Incorporated (1975).

A very complex sequence of glacial and interglacial deposits were created as the ice advanced from the north at least four times during the Pleistocene Ice Age, overriding and

compacting the previous glacial material and depositing a new veneer of silts, sands, gravels, and boulders. Each time, the ice then retreated, leaving behind streams and lake sediments in the Commencement Bay basin. The last ice advance, called the Vashon Glaciation, occurred about 15,000 years ago and left a layer of glacial till (an unsorted mixture of clay, silt, sand, and gravel deposited at the base of the glacier) over much of the upland surface. As the glaciers began to melt and retreat, major land-shaping actions took place. Meltwater streams deposited loose gravels on top of the till in a gravelly outwash plain during the period from 13,000 to 6,000 years ago, a balance between flooding by the sea and filling processes by the Puyallup river existed, and sea level rose until about 6,000 years ago when modern sea level was attained. Sediments were either dispersed across flooded tidal marshes, or deposited off the end of the advancing Puyallup River delta, depending upon whether flooding or filling dominated. As sea level rose, the delta was built up and out.

Following the retreat of the Vashon Glacier, two mudflows dramatically altered the Puyallup River valley. Approximately 4,800 years ago, the Osceola Mudflow originated on Mt. Rainier and covered 125 square miles of Puget Sound lowlands to depths of 75 feet in some places (Ecology, 1992). The Electron Mudflow, a much smaller mudflow, formed about 500 years ago and moved about 35 miles down the Puyallup River valley to Orting, where mudflow depths were up to 16 feet. Since these massive mudflows, the Puyallup River and White River valley floors have been modified by alluvium deposits (ranging in thickness from a few feet to 600 ft) from the rivers and streams throughout the lower Puyallup River basin (Ecology, 1992).

The two main soil associations in the primary study area are glacial till and alluvium. Glacial till was left behind by the retreating glaciers and is generally found in upland deposits. Alluvial deposits underlay most of the major river valleys in the study area; these deposits are quite productive for agriculture. Soils adjacent to Commencement Bay consist almost entirely of fill material (artificially modified surface material) overlying natural delta sediments. The majority of the soils in the Puyallup delta region have been described as Tacoma muck with Puget silt loam dominating Hylebos and Wapato Creeks (Simenstad et al., 1993).

2.8 Topography and Surface Water Hydrology

2.8.1 Primary study area

Commencement Bay is surrounded predominantly by flat coastal beaches and tidal flats. Steep shoreline bluffs with high erosion and slippage hazards border the estuary to the north and south (USFWS and NOAA, 1995). The main tributaries to the Bay are the Puyallup, Carbon and White Rivers, and Hylebos and Wapato Creeks. Puget Creek is a minor independent tributary to the Bay. The Puyallup River is the principal source of both fresh water and sediment to the Bay, though Hylebos and Wapato Creeks all contribute flows to the Bay and simultaneously a proportionate amount of the sediment load (U.S. Army Corps of Engineers et al., 1993).

The major features of water circulation in the Bay are a shallow surface layer (6 to 17 feet thick) consisting of low-salinity water from the Puyallup River, and a more uniform, saline deep layer (Commencement Bay Natural Resource Trustees, 1995). The surface layer is influenced primarily by tidal flows, but is also strongly affected by wind stress. The surface currents within Commencement Bay push sediments flowing from the Puyallup River into the waterways, and then move them around the northeastern shoreline and Brown's Point (Ecology, 1992). These sediments tend to deposit in various locations throughout the Bay. Tidal currents in the Bay are quite strong compared to many other deep-water areas of Puget Sound and are sufficient to induce substantial resuspension of fine sediments of the deep Bay (from Commencement Bay Natural Resource Trustees, 1995). The deeper layer is continuous with the East Passage water of the main body of Puget Sound and circulation is dominated by tidal flows. In general, currents in the waterways vary longitudinally and with depth.

2.8.2 Expanded study area

The basin is central to the communities of Tacoma, Fife, Puyallup, Sumner, Orting, Auburn, the Puyallup Tribe of Indians and Muckleshoot Indian Tribes; the many streams and creeks flowing into the river influence even more communities and neighborhoods (Ecology, 1993).

The Puyallup River drains an area of approximately 1,000 square miles of mountains and lowlands, and discharges an average of 1.1×10^{11} cubic feet of water annually (Ecology, 1980a). Peak flows in the Puyallup River occur during winter (December) and late spring (May to June). As measured at USGS gaging station no. 12101500 near Sumner, the lowest 7-day average flow with a 10-year recurrence is 757 cubic feet per second. The highest 7-day average flow with a 10-year recurrence is 18,000 cubic feet per second. The White River and Carbon River contribute approximately 50 percent and 30 percent of the Puyallup River flow, respectively.

Long-term mean-annual precipitation ranges from 37 inches at Tacoma near the mouth of the Puyallup River (elevation 267 feet), to 59 inches at Greenwater in the White River drainage (elevation 1, 730 feet), to greater than 100 inches at some locations in the Basin near the crest of the Cascade Mountains (Prych, 1988). The predominant form of precipitation varies from rain at the lower elevations, to snow at the upper elevations, with approximately 65 percent of the precipitation falling from October through February. Annual peak stream discharges usually occur in late fall or winter. Historically, both the White River and Puyallup River caused extensive flood damage in the early spring following rain-on-snow events, but since 1943 Mud Mountain Dam has effectively reduced the magnitude of flood waters below the confluence of the White River and Puyallup River (Ecology, 1995a).

Meltwater from the Puyallup and Tahoma glaciers on the southwest slopes of Mt. Rainier is the principal source of water and sediment to the Puyallup River proper, but numerous tributaries also feed the system. There are 728 identified rivers and streams within the Basin, providing 1,287 linear miles of drainage. The largest tributaries to the Puyallup are

the White and Carbon Rivers, both of which originate on the northern slopes of Mt. Rainier (elevation 14,411 feet).

The Puyallup River originates in Mount Rainier National Park and flows, for the first few miles, through narrow, steep-walled valleys, then down steep gradients, cascades, and pool/riffle areas. Outside of park boundaries, the river is surrounded by public and private forests, which provide the bulk of the remaining riparian habitat along the river. The Puyallup continues down past the Carbon River to the confluence with the White River, flowing through areas containing a great deal more human activity and, in particular, agriculture and residential development.

The White River drains a 494 square mile basin, which originates on Mount Rainier, and flows approximately 68 miles to the confluence with the Puyallup River at Sumner (South Puget Sound Spring Chinook Technical Committee, 1995). The combination of glacial action, high gradient and erosion of the Osceola Mudflow produces the tremendous volumes of sediment (an estimated 440,000 to 1,400,000 tons/year) transported within this system (Nelson, 1979). The mean monthly flow of the White River at Mud Mountain Dam is 1,500 cfs, with the lowest flows occurring in September and October and the highest flows occurring during May and June. The White River is of particular significance to the region because it supports the sole remaining spring chinook stock in south Puget Sound.

Below the confluence with the White River, the Puyallup River continues northwest towards Commencement Bay through open farmland, heavily populated areas, and intense industrial development near its mouth. The river has been extensively channelized through this section with large flood control dikes. The lower elevations of the Puyallup River are in a broad, predominantly flat, alluvial plain with a slight downward gradient toward the Bay. Several major human modifications to the Puyallup-White River system have altered the hydrology of the Basin. These modifications include:

- The rerouting of the lower Puyallup River in the early 1900s from its southern location to a channel that approximately bisects the estuary;

- construction of Electron Dam, Flume, and Powerhouse in 1903 completely blocked migration and access to 26 miles of spawning habitat above the dam for anadromous fish; diversion of water to the Electron Flume during certain low flow periods alters fish habitat and reduces flows in a 10 mile reach between the Electron Dam and Electron Powerhouse, thereby blocking migration and access to spawning areas on the mainstem and tributaries for certain runs of native salmon;

- construction of a concrete dam in 1915 to divert the White River from the Green River into the Stuck River Valley;

- construction of Mud Mountain Dam, which began operation in 1943, for flood control; the dam blocks passage of eroded materials downstream and

is a complete barrier to upstream passage of migratory fish; a trap and haul system, operated by the Corps of Engineers, is used to move fish over the dam; the most significant impacts of the dam are to the critical stock of White River spring chinook salmon and include juvenile mortality associated with passage through tunnels in the dam and abnormal sediment deposition resulting from reservoir operation (South Puget Sound Spring Chinook Technical Committee, 1995);

- dredging of a 2.2 mile channel and construction of levees in 1950 along the lower Puyallup River to control flooding; and

- Puget Sound Power and Light's White River Project has diverted water, altered instream flows, blocked fish migration, stranded fish, and exposed them to predation (Ecology, 1995a). These projects are unlicensed, unregulated, and currently divert 64% of the annual river volume out of the river channel over a 20- mile reach (South Puget Sound Spring Chinook Technical Committee, 1995).

The interaction of surface and groundwater appears to be substantial throughout the Puyallup River basin. Hydraulic continuity between ground and surface water adds complexity in determining water availability for either development or restoration. Groundwater withdrawals within all the drainages have the potential for adversely impacting critical surface water flows (Ecology, 1995b). A number of other factors affect water availability and water quality, including surface water diversions; groundwater withdrawals in areas of hydraulic continuity or recharge to the Puyallup River, Hylebos Creek, and Wapato Creek; and construction of roads and other impervious surfaces in groundwater recharge areas of these waterbodies. These activities reduce stream flows needed for fishery habitat, increase temperature of remaining stream flows, and result in other changes to fishery habitat. Groundwater withdrawals and development in the expanded study area and development tend to have the same impacts (Ecology, 1995b).

2.9 Water and Sediment Quality

2.9.1 Surface water quality

2.9.1.1 Primary study area

Releases of hazardous substances from businesses, industry, municipalities, and other sources in the Commencement Bay area have caused and contributed to a significant decline in the quality of water and associated sediments in Commencement Bay. EPA (1989) has designated the Bay a Superfund site. Numerous point and nonpoint sources of contaminants empty into the Bay. The history of industrial use, high urban density, and instream flow diversion have contributed to significant water quality degradation resulting from elevated bacterial levels, higher than normal temperatures, chemical pollutants in the water, and habitat degradation (Ecology, 1995a).

Contaminants which exceeded EPA ambient water quality chronic criteria (AWQC) in Commencement Bay and associated waterways included arsenic, copper, lead, and PCBs (Table D-11, Appendix D). Contaminants exceeding the AWQC in outfall samples, representing waters discharging into the Bay, included metals (arsenic, cadmium, copper, lead, mercury, nickel, zinc), pesticides (dieldrin, endosulfan, endrin, DDT), pentachlorophenol, and total PCBs. Semivolatile organic compounds, including polynuclear aromatic hydrocarbons, were also detected in outfall samples, although concentrations were at levels below the AWQC (Commencement Bay Natural Resource Trustees, 1995a). Water quality standards for fecal coliform have also been exceeded in inner Commencement Bay, Hylebos Creek, Wapato Creek, and the Puyallup River, as well as in other rivers and creeks in South Puget Sound (Ecology, 1995a). Water quality classifications within the Bay range from Class A in the outer bay, to Class C in the Thea Foss Waterway. The Puyallup River ranges from Class B near its mouth to Class A at the edge of the primary study area. Ecology and the Puyallup Tribe have drafted comparable water quality standards which apply to portions of the River under State and Tribal jurisdiction, respectively, in discrete portions of the River within the primary study area. A more detailed discussion is found in the Commencement Bay Phase 1 Damage Assessment (Commencement Bay Natural Resource Trustees, 1995).

Designated uses for Class A waters are fish rearing, spawning, and harvesting; salmon migration; clam, oyster, and mussel rearing, spawning, and harvesting; crab and shrimp rearing, spawning, and harvesting; primary contact; secondary contact; navigation; and wildlife habitat. Designated uses for Class B waters are the same as for Class A waters with the exception that primary contact is not a designated use. Designated uses for Class C waters are secondary contact, navigation, and wildlife habitat. However, Commencement Bay proper is considered water-quality limited, which is defined as an area where it is known that the water quality does not meet applicable water quality standards and/or is not expected to meet applicable water quality standards, even after the application of technology-based effluent limitations (Commencement Bay Natural Resource Trustees, 1995).

2.9.1.2 Expanded study area

Water quality classifications for the reaches of the Puyallup and White Rivers within the expanded study area are either Class A or Class AA. Fishing and swimming are impaired uses within most of the streams and rivers in the lower Puyallup River basin (Ecology, 1993). Naturally high turbidity (range 1.8 to 180 nephelometric turbidity units) characterizes the water quality of the Puyallup River, as approximately 908,000 metric tons of suspended glacial sediment (range 14 to 406 milligrams per liter) are discharged during a year of normal streamflow (Ecology, 1980b). This high turbidity leads to deposition with Commencement Bay, contributing to natural recovery of some contaminated sites through capping of the contaminated sediments.

A recent Ecology (1995a) report summarized Ecology's highest priority issues and actions necessary to protect or restore water quality in the South Puget Sound Water Quality

Management Area (WQMA). Of highest concern to Ecology in the Puyallup-White River basin were:

- instream flows and/or habitat for spring chinook in the White River system;
- water quality parameters affecting salmonid habitat and temperature in the Clearwater and Greenwater Rivers, Boise Creek, and Scatter Creek;
- fecal coliform in Puyallup and White Rivers, Hylebos Creek (including the West Fork), tributaries to Clark's Creek, and Wapato Creek;
- pH and nutrients in the White River and its tributaries;
- dissolved oxygen in Wapato Creek;
- organics, PCBs, arsenic, lead, mercury, zinc, and fecal coliform in inner and outer Commencement Bay; and
- organics and metals in Thea Foss Waterway.

Other surface water quality issues requiring analysis in the Puyallup-White River basin and Commencement Bay study areas, in order to determine potential impacts upon the restoration of the injured natural resources are:

- instream flow, between Electron Dam and Electron Powerhouse;
- salmon and steelhead passage to the habitat areas above the Electron Dam;
- instream flow and habitat in Wapato and Hylebos Creeks;
- gravel removal activities impacting fish habitat;
- stormwater discharges from municipal and industrial sources;
- control of pollution from unregulated sources;
- waste water discharges from municipal wastewater facilities and industrial discharges; and
- construction of impervious surfaces in groundwater recharge zones.

2.9.2 Sediment quality

A detailed preliminary discussion of the extent of sediment contamination in Commencement Bay is found in the Commencement Bay Phase 1 Damage Assessment report (Commencement Bay Natural Resource Trustees, 1995). It is not the intent of this section to report the Phase 1 report, but to highlight issues pertinent to the affected environment.

Industrial, commercial, and municipal activities in Commencement Bay have resulted in the release of hazardous substances and discharges of oil into the estuarine environment, either directly by disposal and discharge to land, water and the atmosphere, or indirectly as nonpoint sources of pollution (Shapiro and Associates, 1992). Contaminants were released into the waterways and Commencement Bay as a result of operations of pulp and lumber operations, shipbuilding and marinas, chlorine production and chemical manufacturing, oil refining, aluminum smelting, railroad operations, and automotive repair services. Several of the waterways contained high concentrations of metals, polynuclear aromatic hydrocarbons, PCBs, chlorinated butadienes, hexachlorobenzene, and chlorinated pesticides (Commencement Bay Natural Resource Trustees, 1995).

Under the Puget Sound Water Quality Management Plan and the Washington State Sediment Management Standards (SMS), Ecology is developing contaminated site lists to prioritize cleanup of sediment in Puget Sound. The first step in this process is to identify "station clusters of potential concern" based on exceedance of chemical and biological screening levels (CSL) as defined in SMS (WAC 173-204). This step has been completed for Commencement Bay, and identified clusters are shown on Figure 2.9-1. Comparison with Figure 2.9-2 shows that the SMS clusters overlap to a large degree with the Superfund sediment problems areas. Therefore, remediation of the Superfund problem areas, as described above, will also remediate many of the SMS clusters of potential concern. Remediation has occurred in the Sitcum Waterway.

The subsequent steps in Ecology's sediment cleanup process include conducting hazard assessments for each of the clusters of potential concern based on sediment quality, physical characteristics, biological resources, and human uses. Following this evaluation, clusters exceeding the CSLs will be identified as contaminated sediment sites and ranked according to their relative degree of hazard to human health and the environment. Ecology's potential remediation of clusters within Commencement Bay not addressed by the Superfund program will be based on how these clusters rank compared to other clusters in Puget Sound.

Figure 2.9-2 shows other CERCLA and Resources Conservation and Recovery Act (RCRA) sites in the Commencement Bay area. Remediation schedules for these sites are not addressed in this EIS, because remediation at most or all of these sites is not expected to affect NRDA-related habitat restoration projects.

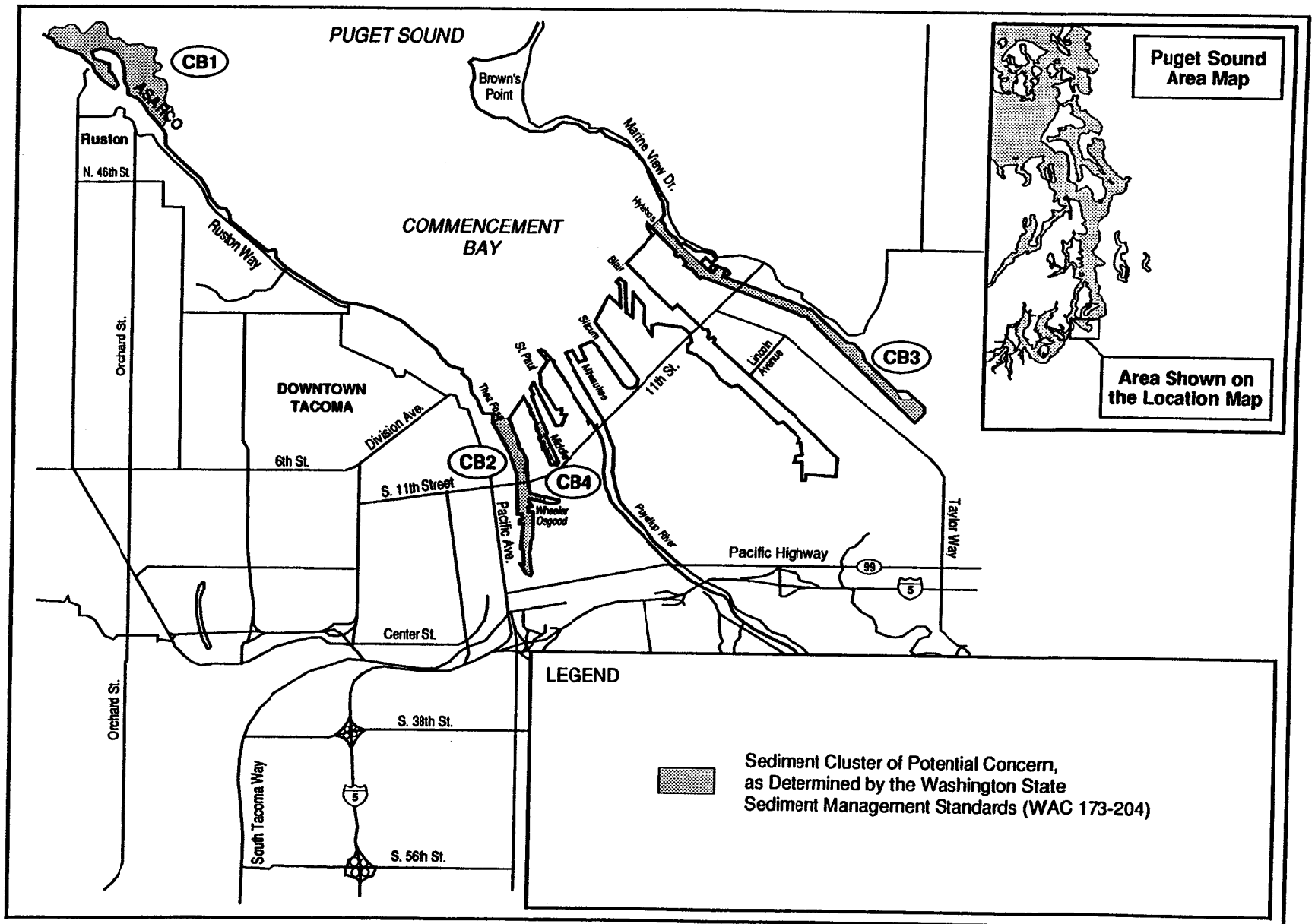


Figure 2.9-1. Sediment Clusters of Potential Concern.

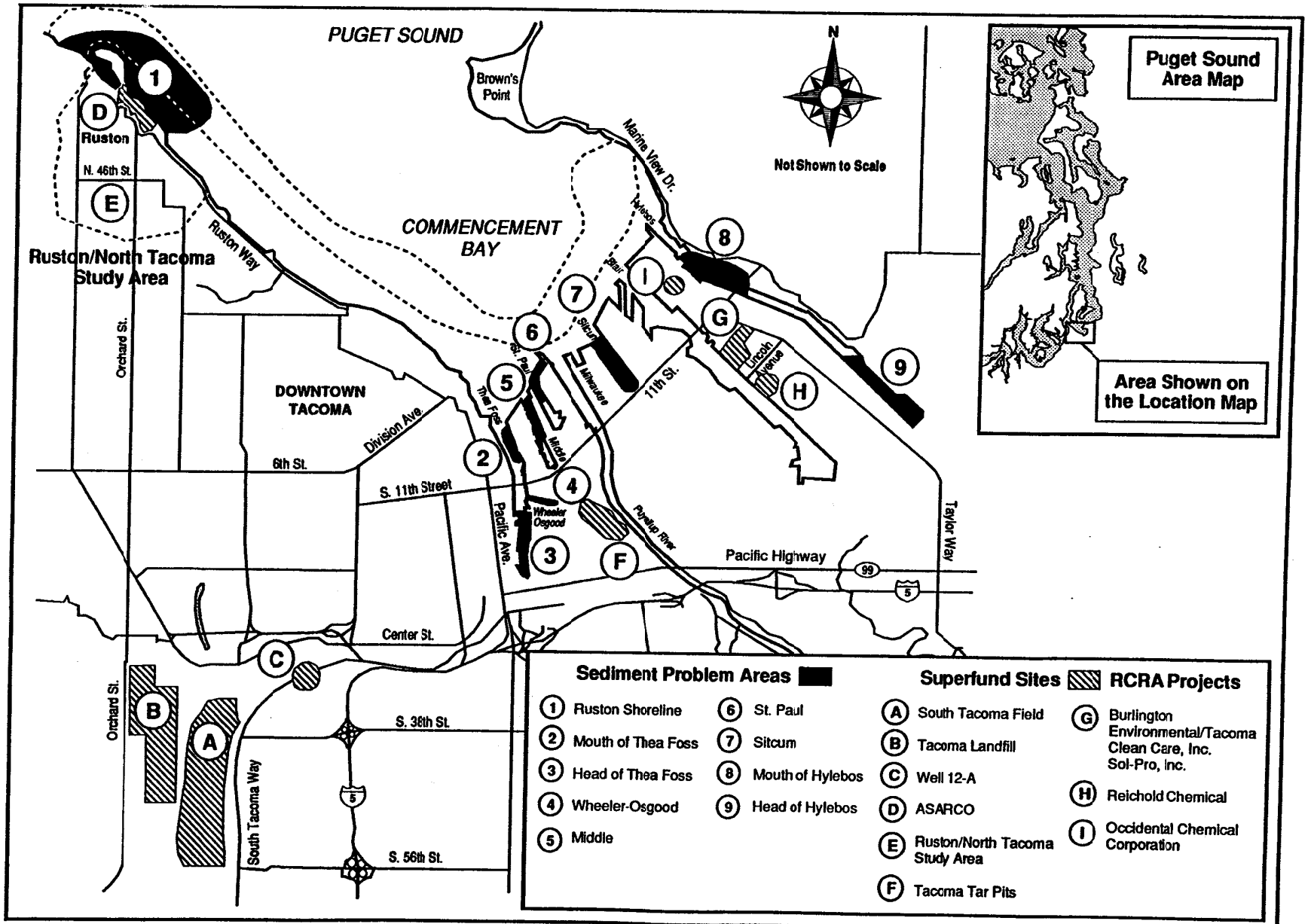


Figure 2.9-2. Sediment problem areas in the Commencement Bay Nearshore/Tideflats Superfund Site, and Other CERCLA (Superfund) and RCRA sites in the Commencement Bay area.

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2.10 Air Quality

The objectives of this evaluation are to describe existing air quality conditions in the Commencement Bay study area.

2.10.1 Existing conditions

Air quality conditions in the study area are influenced by several factors, including climate, topography, industrial, municipal, and residential pollution sources, and vehicular air emissions.

Mild temperatures dominated by cool moist winds from the Pacific Ocean characterize the climate in Puget Sound. Summers are moderately warm and dry; winters are mild and wet. Winter rainfall in the Tacoma area averages from 3.5 to 6.5 inches per month in October through March, with average daytime temperatures ranging in the 40's (Fahrenheit) and overnight lows in the low to mid-30's. Snow and freezing temperatures are infrequent and of short duration. Winter winds are generally southwesterly, with a mean monthly wind speed of 7 to 9 miles per hour (Dames and Moore, 1981).

Summer temperatures in Tacoma range from nighttime average lows in the low to mid-50s to highs in the 70's. Summer rainfall averages 1 to 2 inches per month in May, June, and September, and less than 1 inch per month in July and August. Average annual precipitation in Tacoma is about 37 inches (Dames and Moore, 1981). Northerly winds are typical from June through October.

Winds have a significant impact on air quality in terms of dispersion, direction of transport, and stagnation when winds are light or absent. Winds are measured at three locations in Tacoma (Figure 2.10-1) by the Puget Sound Air Pollution Control Agency (PSAPCA). The topography in the Commencement Bay area is conducive to stagnant conditions during periods of temperature inversion. The Puyallup River delta, which forms the tideflats area, is bordered on the northeast and southwest sides with hills of up to 500 feet in elevation. Thus, Commencement Bay lies in a "bowl" from which air contaminants are not easily dispersed during periods of calm winds.

2.10.2 Ambient air quality

A number of diverse industrial and transportation emission sources contribute to the air contaminant loading in the Tacoma tideflats area, including a pulp and paper mill, several chemical manufacturing plants, an aluminum smelter, a municipal incinerator, and vehicular traffic. These emissions, under the influence of complex meteorological conditions result in a mixture of contaminant loadings that vary from receptor point to receptor point, and vary over time. The following discussion of baseline air quality is based upon direct measurements of ambient levels of the criteria pollutants at several specific locations within the primary and expanded study areas.

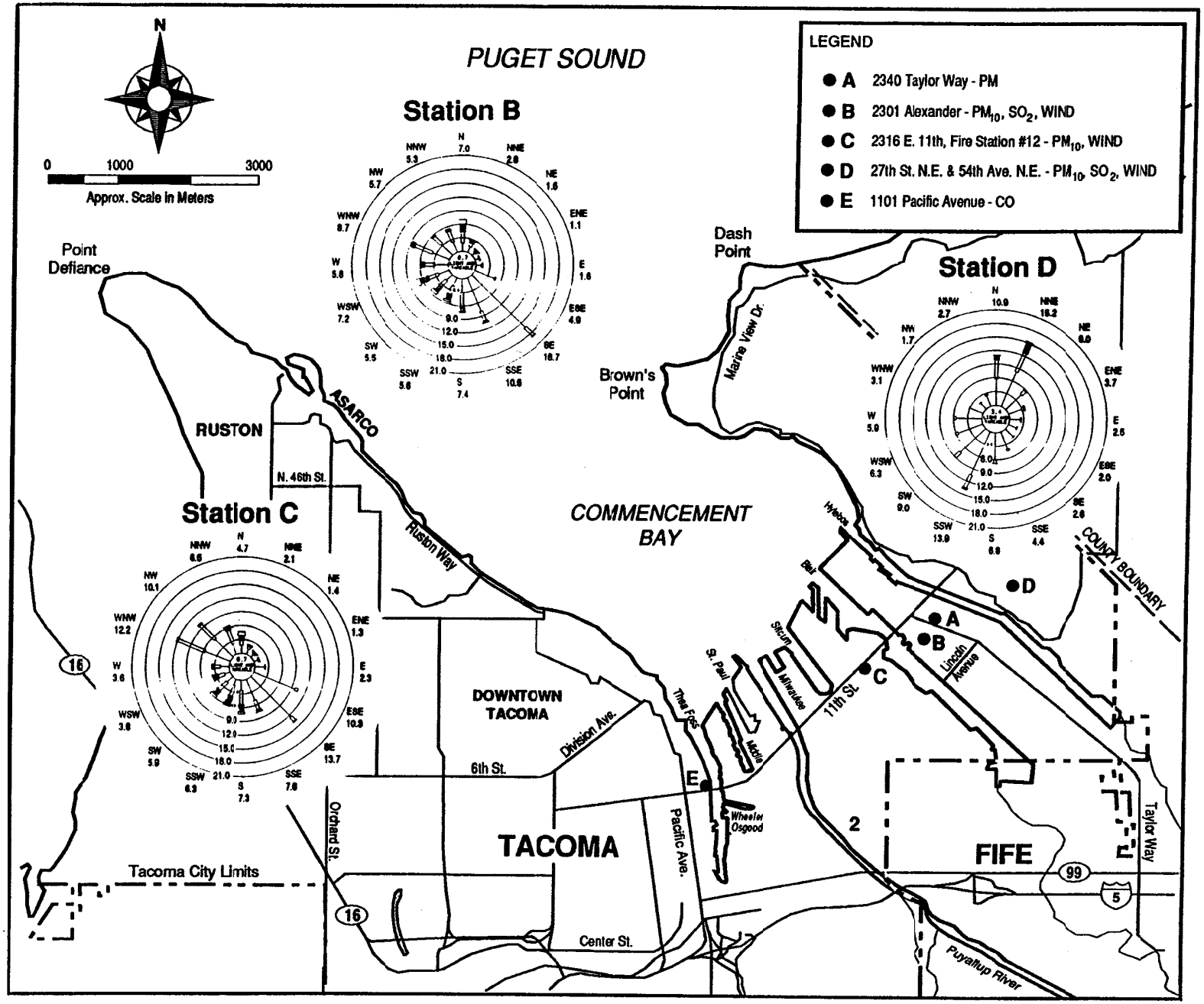

Figure 2.10-1. Primary Study Area air monitoring locations, and wind roses for three locations.

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The Port of Tacoma industrial area (within the primary study area) is a moderate nonattainment area for particulate matter National Ambient Air Quality Standard. Particulates of 10 micrometers diameter and smaller (PM-10) generally include dust, soot, and combustion byproducts containing sulfur, nitrogen and metals. There are three main sources of PM-10 that occur within the primary study area: industrial stack emissions; industrial fugitive emissions (emissions not dusted through a stack); and area source emissions (e.g., those that derive from fixed locations such as wood stoves or mobile sources such as cars). While the major sources of PM-10 in the shoreline areas is the result of wood combustion, the majority of this is of industrial origin. Residential wood smoke constitutes an insignificant portion of the shoreline emission inventory. This is a reflection of the limited residential development within the non-attainment area (Ecology, 1991b). Evaluation of PM-10 impacts is usually accomplished through modeling of specific point source emissions. PSAPCA operates four PM-10 monitors within the study area.

The Tacoma urban area is a moderate nonattainment area for carbon monoxide. Ozone, a product of photochemical reactions in the atmosphere, has also been measured at levels above the standard in the Puget Sound region, which has been designated as a marginal ozone nonattainment area. The Tacoma area is in compliance for sulfur dioxide (SO_2), lead, and nitrogen dioxide. For the years 1991, 1992, and 1993, there were no measured violations of the standards for PM-10, carbon monoxide (CO), or ozone in the Tacoma area (PSAPCA, 1994). Those three pollutants are described below.

Motor vehicles are the primary source of CO in the Puget Sound region, with less significant contributions from residential wood burning, other gasoline operated equipment, and slash burning. Air quality impacts from vehicle traffic are usually evaluated through a micro-scale analysis of traffic-related CO emissions. Ecology operates a CO monitoring station at 1101 Pacific Avenue in Tacoma, within the primary study area.

Ozone is a product of the reaction of volatile organic hydrocarbons and nitrogen oxides (NO_x) under the effect of ultraviolet radiation. Motor vehicles are a major contributor to ozone production. The highest ozone levels in the Commencement Bay area are typically observed on very warm days from May through September. Analysis of ozone impacts is based on NO_x and hydrocarbon emissions, and is usually conducted on a regional or meso-scale basis. PSAPCA operates two ozone monitors on a seasonal basis, located in Enumclaw and La Grande, Washington.

Daily air quality in Tacoma was reported by PSAPCA in 1993 as 302 "good" days, 63 "moderate" days, and 0 "unhealthful" days, using the National Pollutant Standards Index (PSAPCA, 1994). Any excursion over a short-term national primary air quality standard would cause the Index to register in the "unhealthful" or "very unhealthful" category.

Baseline air quality conditions for the study area were determined through review of air quality data collected in the area by PSAPCA in 1993. Monitoring stations for PM-10, SO_2, and CO are located within the primary and expanded study areas (Figure 2-10.1); however, the data collected from these monitors may not be representative of air quality conditions

throughout the expanded Commencement Bay study area. Ozone monitoring stations are located downwind from the Seattle and Tacoma metropolitan areas. Airborne lead levels are measured by PSAPCA at two locations in Seattle only. Baseline air quality data are summarized below (PSAPCA, 1994).

- The maximum 1-hour CO concentration recorded in 1993 was 10.7 parts per million (ppm), which is below the ambient air quality standard of 35 ppm. The maximum 8-hour CO concentration was 7.8 ppm compared to the standard of 9.0 ppm.

- The highest annual arithmetic average for PM-10 was 33.4 micrograms per cubic meter ($\mu g/m^3$), which did not exceed the ambient standard of 50 $\mu g/m^3$. The highest 24-hour PM-10 concentration was 120 $\mu g/m^3$, also below the 150 $\mu g/m^3$ standard.

- The highest daily maximum 1-hour average for ozone measured in the state was 0.103 ppm, at Pack Forest in La Grande. The ozone standard is 0.12 ppm.

- Maximum SO_2 concentrations for the 1-hour, 3-hour, 24-hour, and annual averages were 0.097, 0.070, 0.031, and 0.009 ppm, respectively, all below the respective local, state, and federal standards.

- The highest 3-month lead concentration measured was 0.37 $\mu g/m^3$, below the ambient standard of 1.5 $\mu g/m^3$ (Harbor Island, Seattle).

2.11 Noise

The objective of this section is to describe existing noise sources and levels in the Commencement Bay study areas.

2.11.1 Existing conditions

Previous noise studies have been conducted for other proposed projects, using noise monitors at locations within the study areas. No baseline noise level monitoring was conducted for this programmatic EIS. Results of studies discussed below include the proposed extension of State Route 509 through Tacoma (US DOT, 1990), the proposed Northeast Overlook residential development in Tacoma (Yantis, 1993), and a proposed easterly extension of 176th Street in Tacoma (TAMS Consultants, 1993b). These recent studies provide information regarding baseline noise levels within the study area. In addition, general descriptions and noise level measurements from a 1980 study conducted by Dames and Moore (1981) in the Commencement Bay area are discussed. Should noise impacts from restoration project activities (described in Section 4.0) be anticipated to exceed state and local standards, additional baseline noise level monitoring in the specific project area may be necessary.

One study was performed in conjunction with the EIS prepared for the construction of an extension of State Highway 509, from I-705 to East 11th Street and Marine View Drive in Tacoma (US DOT, 1990). Noise levels were monitored at six locations (Figure 2.11-1) and found to be less than the FHWA roadway criteria at all sites. Qualitative results of monitoring were reported as follows (US DOT, 1990; actual noise levels in dBA were not reported):

Location Sound Description

1 City Park along the Thea Foss Waterway - Train noises were dominant. Others were railroad crossing alarms, bird, and vehicle traffic noises on I-705. On a second visit, traffic noises dominated.

2 Dike Road, North Side of Puyallup River - (Lincoln Avenue Wetlands) Traffic noise was dominant. Manufacturing, forklift, airplanes, bird, and train noises were audible.

3 East-West Road, between Port of Tacoma Road and Alexander Ave. - Traffic noise was dominant, followed by horns, voices, vehicle back-up alarms, and a loose railroad rail.

4 East 11th Street, Northeast of Alexander Avenue - Traffic noise was dominant, followed by airplanes, horns, and bridge opening alarms.

5 East 11th Street, North of the Hylebos Waterway - Traffic noises were dominant, followed by aircraft and car stereos.

6 Northeast corner of South 21st Street and Pacific Avenue (Specific information missing for this location)

Another noise study was conducted in 1992-93 for the proposed Northeast Overlook residential development in Tacoma (Yantis, 1993). This study recorded several 24-hour measurements of existing sound levels at the proposed residential development site located on the bluff above the tideflats, near the junction of Marine View Drive and Norpoint Way (Figure 2.11-1).

Noise in this area was dominated by traffic sounds, with ships on the Hylebos Waterway and industrial noise from the Port of Tacoma and other operations along Marine View Drive also audible. The 24-hour day-night equivalent noise levels measured in this study ranged from 52 dBA to 73 dBA. The predicted maximum noise level was estimated to exceed the Pierce County standard at one monitoring location. In addition, the maximum noise level was predicted to exceed the Federal Interagency Committee on Urban Noise (FICUN) criterion at one location. Due to the high baseline noise levels at these locations, specific mitigation measures were proposed which would decrease the noise impact at the proposed residential development receptor locations.

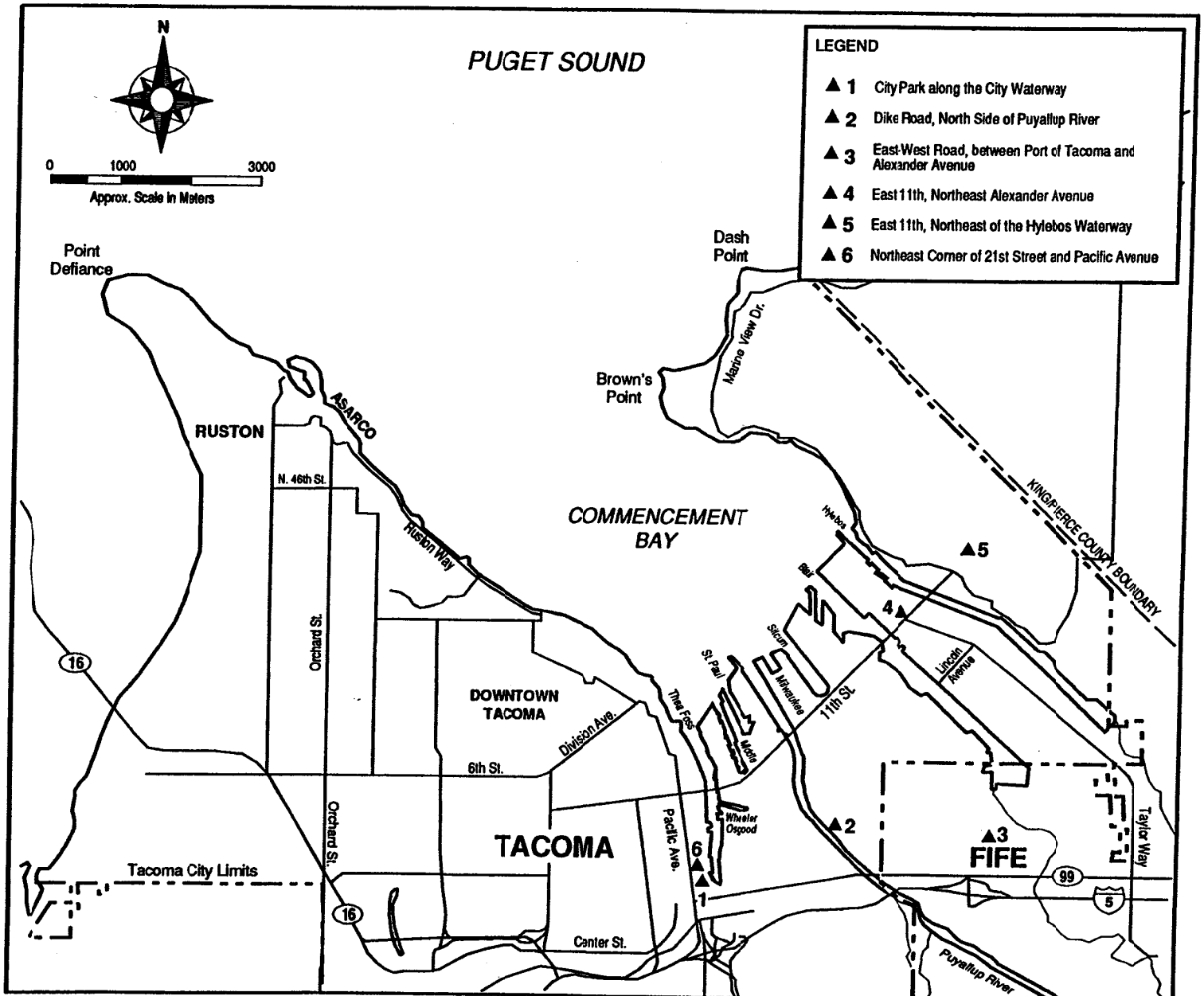

Figure 2.11-1. Noise measurement locations, Commencement Bay area.

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A set of noise measurements was obtained in 1993 in the study area for a proposed extension of 176th Street (TAMS Consultants, 1993b) in an area of Tacoma adjacent to the Puyallup River and east of the Pierce County Airport (Figure 2.11-2). Noise levels were measured at six locations representing the most sensitive receptors identified along the proposed road extension routes, which were all residential locations. Maximum hourly noise levels ranged from 47.5 to 51.9 dBA, none exceeding state or local standards or federal (FICUN) housing guidelines.

Older noise studies conducted by Dames and Moore in 1978 and 1980 (Dames and Moore, 1981) provide general information on noise sources that is still applicable today. Noise levels in the north shore area, along the bluffs from Brown's Point to the intersection of Marine View Drive and East 11th Street, are primarily the result of traffic on Marine View Drive and intermittent background industrial noise. Near the Hylebos Waterway, traffic noise levels were 59-63 dB along Marine View Drive (Dames and Moore, 1981).

Noise levels in the port industrial area, between the Hylebos and Thea Foss Waterways, are attributable primarily to the extensive industrial activity in the area. The major arterials in this zone are the most significant single sources of noise, including East 11th Street, Port of Tacoma Road, Portland Avenue, and Lincoln Avenue. Calculated day-night equivalent noise levels were 70 to 80 dB at a distance of 100 feet from the center of these roadways, except for Lincoln Way, which was 60 to 80 dB (Dames and Moore, 1981).

The south shore of Commencement Bay, including the area from downtown Tacoma to Point Defiance Park, is influenced by traffic and industrial noise. The Burlington Northern Railroad runs along most of the shoreline. Traffic on Schuster Parkway and Ruston Way contribute most heavily to noise in this area (Dames and Moore, 1981). The results of noise level measurements conducted in the studies (US DOT, 1990; Yantis, 1993; TAMS Consultants, 1993b; Dames and Moore, 1981) noted in the previous section, indicate that residential, commercial, and industrial receptors revealed noise levels generally within the anticipated (and acceptable) ranges (with a few exceptions), as described by state and county regulations and federal guidelines. Although the documented noise monitoring did not span the entire primary study area, and localized sound levels can vary significantly from point to point, these data provide a general characterization of the noise levels within the study area.

There are fewer documented noise measurements in the expanded study area. Noise levels in the Puyallup valley can be anticipated to reflect land use activities, with residential areas experiencing noise levels of approximately 55 dBA and less, commercial areas 50-60 dBA, and industrial areas 60-70 dBA. Higher noise levels are anticipated adjacent to heavily traveled roadways.

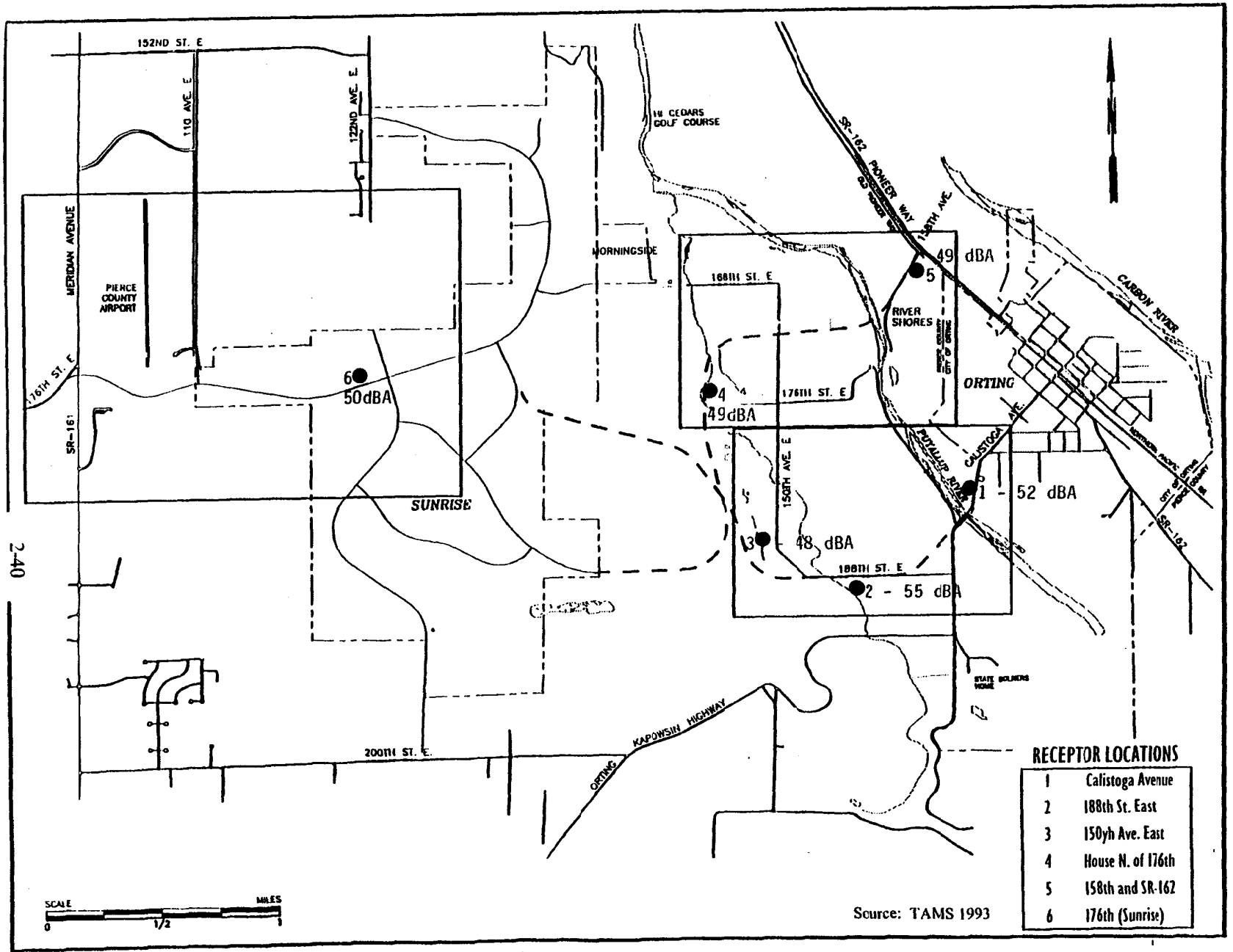

Figure 2.11-2. Noise measurement locations, Puyallup River Basin.

2.12 Land Use and Aesthetics

The land use attributes considered in this section are general land use patterns, land ownership and land management. Public lands and access opportunities are also addressed. In addition, this section considers the natural and manmade features that define the area's aesthetic qualities. The region of influence for land use and aesthetics includes both the primary and expanded areas of study covering approximately 1,000 square miles.

2.12.1 General land use patterns and aesthetic qualities

The primary study area comprises approximately 16,000 acres (25 square miles) and includes a portion of Commencement Bay and its shoreline, as well as the estuarine areas of the Puyallup River. Figure 2.2-1 depicts existing land uses and habitat types within the primary study area.

This area consists of uplands, shorelands, open and tidal waters, mudflats, marshes, and vegetated shallows, nearly all of which are located adjacent to or within the boundaries of the City of Tacoma or the Port of Tacoma. Most of the upland area is densely urbanized with extensive industrial, commercial, and mixed use development.

In the central portion of the primary study area, which includes the Port of Tacoma, the Puyallup River and associated waterways, heavy and moderate industrial uses are the principal land uses. In Tacoma's central business district and on both sides of the Port area, moderate and high density commercial development are accommodated. Shoreline uses in these areas include port related industry, warehousing, terminal facilities, marinas, and commercial activities. Figure 2.12-1 shows zoning in the City of Tacoma. Tacoma Harbor Area uses classes, as defined by Chapter 332-30 WAC, are in decreasing order of priority: water-dependent commerce; water-oriented commerce; public access and interim use. Preservation and restoration of natural resources are not addressed by this regulation. Figure 2.12-2 shows Harbor Area designations in the City of Tacoma.

There are numerous public access opportunities to aquatic resources and habitats within the primary study area. In the central portion, due to the constraints of major transportation facilities and industrial activities, these opportunities have focused on the Thea Foss and Hylebos Waterways, and are primarily through marinas. However, under proposed City plans, these opportunities should be enhanced, since a central theme to the City's general and specific plans is the pedestrian orientation of the waterways. To further integrate the waterways, the central business district of Tacoma and the levees of the lower Puyallup River, the City of Tacoma is also proposing a pedestrian and bicycle path system.

On the north shore, moderate density residential and commercial uses are prevalent (Figure 2.12-1). Shoreline uses here focus largely on open space, recreation, and related commercial activities. The south shore is also dominated by moderate density residential and commercial areas. The shoreline nearest the port and downtown area does allow for deep water industrial facilities; however, the vast majority of the south shore, extending nearly to

Point Defiance, is dedicated to open space and recreation. The Point Defiance peninsula, including both lands and shorelines, is designated as a conservancy, thus prohibiting development.

Brown's Point Lighthouse Park is located along the north shore of the Bay, and Dash Point Park is located at Dash Point. Operated by the Metropolitan Park District of Tacoma, these parks offer waterfront access and associated amenities. Commencement/Old Town Dock and Marine Park/Les Davis Pier are located along Ruston Way in the south shore area.

The District offers beaches, fishing piers and moorage facilities at each of these parks. Point Defiance Park is the largest recreational facility within the primary study area. Improvements within the park include such amenities as a boat launch and storage, a marina, and the Tacoma Yacht Club.

The visual resources within the primary area are dominated by the urban development of Tacoma, particularly the intensive industrial and commercial sites and structures that surround the Waterways.

The expanded study area comprises approximately 600,000 acres (1,000 square miles) and includes a wide diversity of land uses. Industrial, commercial, and residential uses are common among the cities and towns located within the Puyallup River basin. These cities include Puyallup, Sumner, and Orting. Other incorporated municipalities in the expanded study area include the cities of Fife, Milton, Buckley, and Bonney Lake in Pierce County; and the cities of Auburn, Algona, Enumclaw, and Federal Way in King County. Vashon and Maury Islands lie within unincorporated King County north of Commencement Bay. East of Orting, the county growth boundary restricts permitted uses largely to rural, agricultural, and forest land preservation. Designated shoreline and critical environmental areas for most of the unincorporated county focus on riverine and wetland environments.

The aesthetic qualities of the expanded study area are exemplified by the natural resources of the Puyallup River basin. The topography varies from elevations at sea level, to the summit of Mount Rainier. Western Pierce County exhibits a flat to rolling terrain which rises to the forested Cascade foothills in the central portion of the county. The Cascade mountains generally range in elevation from 2,500 to 7,000 feet. Waterways of all sizes cross this landscape providing a rich visual quality to the county. The built environment also contributes to the region's visual resources, and includes the various rural communities within the study area, agricultural structures, as well as historic buildings and sites (refer to Section 2.15, Cultural Resources).

Public access on the privately held portions of the open space and agricultural lands within the expanded study area is limited. Hunting and fishing on some of these lands occurs with the permission of the land owner. Of particular note is the importance of fishing along the non-marine water of the Commencement Bay basin. Organized recreational activities and facilities provide opportunities for public access to a variety of natural resources. Some of the facilities operated by Pierce County include Swan Creek Park, Lidford Playfield,

Edgemont Playfield, Riverside Park, Lake Tapps North Park and Wilkeson Creek Park (Pierce County, 1993). Pierce County is also proposing a county-wide multi-purpose trail to link recreational and public facilities. The Nisqually Delta/Foothills Trail is also under development to extend along the coast and inland to Mount Rainier.

In the southeast portion of the county, the dominant land uses and visual resources are the Mount Baker-Snoqualmie National Forest and Mount Rainier National Park (Figures 2.2-2 and 2.12-3). The former covers 1.7 million acres (2,656 square miles) of the western slopes of the Cascades, only a small portion of which is in the expanded study area. The National Forest includes approximately 600,000 acres (938 square miles) of timberland, much of it located outside of the expanded study area. In addition, it offers the full range of recreational opportunities including camping, hiking, boating and hunting. The dormant volcanoes, numerous glaciers, lakes, streams and waterfalls provide abundant scenic views.

The northern portion of Mount Rainier National Park lies within the expanded study area. The entire park encompasses 235,612 acres south of the Mount Baker-Snoqualmie National Forest. The focus of the park is the 14,410 foot high volcano and the associated 34 square mile glacial system. The forests, alpine meadows and abundant wildlife also attract thousands of visitors.

2.12.2 Land ownership

Lands within both the primary and expanded study area are largely privately owned. However, there are state, tribal, and federal lands throughout the area, as depicted on Figure 2.12-3, in addition to scattered city and county lands. Notably, the Muckleshoot Indian Reservation of approximately 6 square miles is located along the White River north of Lake Tapps. The 1873 Survey Area of the Puyallup Indian Reservation consisting of 18,000 acres (28 square miles) is located in the immediate area of Commencement Bay along the Puyallup River and both sides of Interstate Highway 5. Areas within the Muckleshoot Reservation and the 1873 Survey Area of the Puyallup Reservation include privately held lands in addition to tribally owned land, and land held in trust by the United States for individual Indians.

Within the primary study area, Washington State owns substantial areas of intertidal and subtidal land in Commencement Bay (Figure 2.12-4). These lands are managed by the Department of Natural Resources for, in decreasing order of priority, water-dependent commerce, water-oriented commerce, public access and interim use. In the upper Puyallup River basin, there is a large federal land holding representing approximately 40 percent of the total expanded study area (Figure 2.12-3). This encompasses approximately 120,000 acres (187 square miles) of the Mount Baker-Snoqualmie National Forest and about 130,000 acres (203 square miles) of Mount Rainier National Park. The U.S. Forest Service manages the 1.7 million acre (2,565 square mile) Mount Baker-Snoqualmie National Forest. The Land and Resource Management Plan is used to guide and direct all management activities; a Final Environmental Impact Statement on the Plan was issued in June 1990 (U.S. Dept. of Agriculture, 1990).

2.12.3 Land management

Much of the primary study area is located within the incorporated area of the City of Tacoma (City), and therefore review of development will generally begin at the city level. Pierce County regulations pertain within the Brown's Point area and throughout most of the expanded study area. However, King County regulations apply to portions of the White River and Hylebos Creek in the expanded study area. Within the 1873 Survey Area of the Puyallup Reservation, the Puyallup Tribe has land use regulatory authority over tribally owned lands and lands held in trust by the United States for individual Indians. Land use regulatory authority over other lands within the 1873 Survey Area falls to local governments under state law. Additionally, throughout the expanded study area, regulations enacted by local municipalities will apply in incorporated areas. The local development review process focuses on compliance with local comprehensive and specific plans, zoning ordinances, and several key state legislative requirements discussed briefly below.

Enacted in 1990, the Growth Management Act (GMA) requires local governments to analyze and plan for specific areas of local and regional concern, such as water quality and availability, agricultural and natural resource land preservation, wetlands protection, and the availability of public facilities and services. The GMA also requires metropolitan and high-growth areas to designate appropriate locations and boundaries for various intensities of new development. In Tacoma, Pierce and King Counties, and local municipalities, such boundaries accommodate high or moderate density development surrounding the primary and/or expanded study area. Rural or low density development is applicable only in the easternmost portions of the expanded study area.

Habitat restoration and environmental remediation are permitted uses within the City's shoreline districts (refer to Figure 2.12-1 for City of Tacoma zoning) and are also permissible in the industrial districts. Restoration activities would also be permissible within most Pierce County zones as a use similar to parks and open space. Restoration activities would be permissible within some King County shoreline zones.

In addition to the state and local regulations, within the primary study area specifically, there are other local planning projects which are basically non-regulatory in nature. Such projects include the City of Tacoma's open space plan, long-range City plans for the Thea Foss Waterway, and the Port of Tacoma's plans for Blair Waterway. The open space plan, administered by the Metropolitan Parks District, identifies a number of potential City open space areas located along shoreline and waterway areas.

Long term potential impacts of current and proposed land use practices in the primary and expanded study areas include reduced stream base flows, increased low flow stream temperatures, increased stormwater discharges, decreased water quality, increased habitat fragmentation, and decreased buffering of riparian, palustrine and riverine habitats from physical disturbance.

2.12.4 Local regulatory requirements

The development of a restoration plan must consider the regulations of the governmental agencies. Which local, state, federal and tribal land use regulations are applicable to a proposed restoration project is determined by the location and nature of the restoration project. Because nearly all of the primary area of study is located within the incorporated area of the City, the initial phases of development review and permitting will generally begin at the city level. Pierce County regulations pertain mostly to the expanded study area, with the exception of the Brown's Point area, municipalities, areas regulated by the Puyallup and Muckleshoot Tribes, and federal lands and portions of the White River within King County. Permitting requirements of other agencies are discussed in Section 4.1. Figure 2.12-1 depicts the zoning districts surrounding Commencement Bay.

2.12.5 Tribal treaties

The Puyallup Tribe of Indians and the Muckleshoot Indian Tribe were parties to the 1855 Treaty of Medicine Creek (1854), and the Treaty of Point Elliott (1855) with the United States. Under these Treaties, the Puyallup and Muckleshoot Tribes ceded Indian lands to the United States while also reserving rights to take fish, including shellfish, at all Usual and Accustomed grounds and stations. Land use actions undertaken by all levels of government may not impair this right. Tribal representatives comment upon proposed projects or plans that might affect reserved Tribal rights within Tribal Usual and Accustomed Areas. Currently, the Puyallup Tribe of Indians use waterbodies within the primary study area for salmon and steelhead trout fishing. Both the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe utilize waterbodies in the expanded study area for salmon and steelhead trout fishing and the exercise of reserved hunting and gathering rights.

Lands held in trust by the United States for the Puyallup Tribe of Indians or its members are subject to the jurisdiction of the Puyallup Tribe and the United States. The same applies for lands held in trust by the United States for the Muckleshoot Indian Tribe. Any activity on lands under Tribal jurisdiction must comply with the Tribe's permit requirements for land use and environmental review as well as all other applicable federal permits.

Approximately 12,500 Puyallup and 1,306 Muckleshoot Tribal members reside in the Basin.

2.13 Utilities and Public Services

Utilities include systems for the provision of water, electricity, natural gas and telecommunication services, disposal of sewage, and the collection of storm water. Public services provided by government entities include police, fire and other public safety services, education, parks and transit.

The primary public water source for the study area is the Green River watershed, a river system located to the north and outside of the primary and expanded study area. Water is piped into reservoirs, and then distributed. The water supply is augmented by wells

throughout the Puyallup River basin. Surface water diversions and groundwater withdrawals for industrial, commercial, agricultural and municipal uses, including small water supply systems and individual wells, have had adverse impacts upon instream flows (Ecology, 1995b).

The City of Tacoma maintains two wastewater treatment facilities which serve the City and surrounding communities on a contract basis. Several other cities in the basin operate wastewater treatment plants. Pierce County operates the Chambers Creek treatment facility, which serves most of the remaining study area. Solid waste disposal in Tacoma is handled by the City Refuse Utility. The location and operation of wastewater treatment facilities, storm sewers, and combined sewer outfalls will have a significant influence upon the siting and success of individual restoration projects.

Public safety services in the primary study area are provided by the City of Tacoma, City of Fife and Puyallup Tribal Police Departments and Fire Departments. Unincorporated areas in the primary and expanded study areas are served by the Pierce County Sheriff's Department or by King County Sheriff's Department. Many of the smaller municipalities in the expanded study area also maintain their own fire and police departments.

The Metropolitan Park District operates numerous parks and open space areas in the primary study area. Some of this property lies along the shores of Commencement Bay or along local rivers and streams. The Park District is involved in habitat preservation and enhancement activities and plans to acquire more undeveloped land for conservation. Other jurisdictions also operate parks or maintain open space. Many of these parks and open spaces provide habitat for a variety of injured and non-injured species of Commencement Bay. Many restoration opportunities may be available in parks and open spaces, but often the designated uses of parks and open spaces conflict with restoration requirements.

2.14 Population and Housing

The Tacoma Metropolitan Statistical Area (MSA), consisting of Pierce County, has shown a pattern of consistent moderate population growth since 1980. From 1980 to 1990, the population grew from 489,100 to 590,500, an increase of nearly 21 percent. From 1990 to 1993, the Tacoma MSA's population grew an additional seven percent to 631,900. Figure 2.14-1 charts population growth in the MSA from 1980 through 1993.

The population of the Tacoma MSA is projected to continue growing, with the population reaching about 850,000 people in 2020. While the current population is concentrated in and around the City of Tacoma, future growth in the MSA is expected to be driven by development in suburban and rural areas of the MSA. This will increase pressure upon land available for restoration, and will impose stress upon restoration sites.

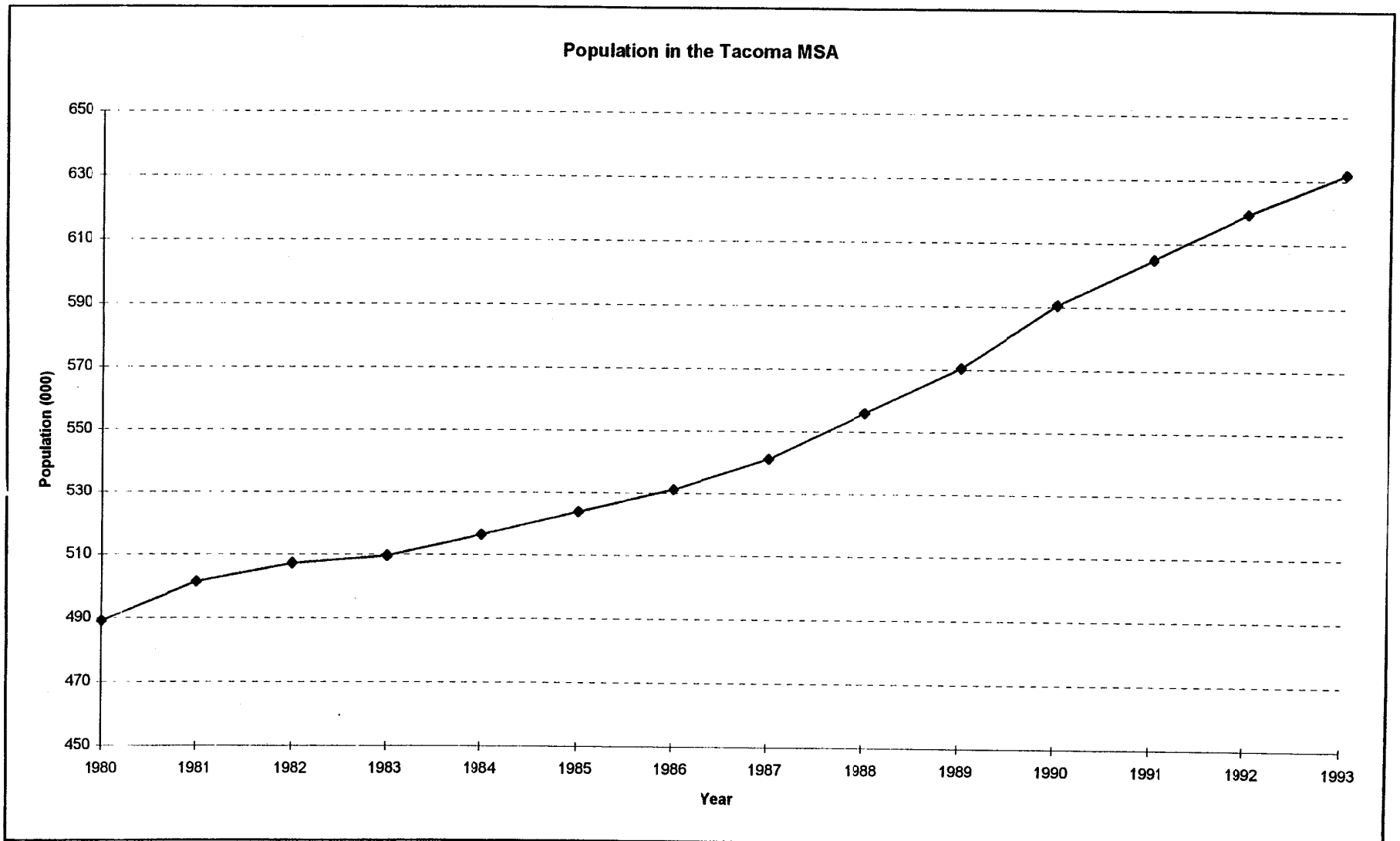

Figure 2.14-1. Population growth in the Tacoma Metropolitan Statistical Area (MSA), 1980-1993.

2.15 Transportation

The Tacoma area is a regional multimodal transportation hub. Interstate 5, the major north-south freeway on the west coast, passes through eastern and southern portions of the City of Tacoma, facilitating connections to Seattle, Portland and other metropolitan areas along the coast. The Port of Tacoma is a fast growing port authority in the state, providing thousands of jobs in the area. The Port of Tacoma is a major container port contributing substantially to the local and state economy. The Port activities in turn generate heavy rail and trucking activity as goods are transported to and from port facilities. In turn, the transportation network imposes restrictions upon available restoration opportunities.

2.16 Cultural Resources

2.16.1 Ethnohistory

The restoration area, the Commencement Bay basin, was historically occupied by the ancestors of the Puyallup Tribe of Indians and the Muckleshoot Indian Tribe. These Tribes, along with six other closely related tribes, are part of the Salish language group. Each tribe historically occupied a particular river drainage. The Puyallup Tribe was one of the saltwater Coast Salish tribes who had access to marine and intertidal resources. In contrast, ancestors of the Muckleshoot Indian Tribe were known as an inland Coast Salish tribe who largely inhabited inland riverine areas (Noel, 1980; Wessen and Stilson, 1987).

The Puyallup Tribe was a party to the Treaty of Medicine Creek, The Tribe consists of the people who historically occupied the Puyallup River drainage. In 1857, the Puyallup Reservation was established pursuant to the Treaty of Medicine Creek. The boundaries were revised in 1873 to give the Puyallups access to Commencement Bay. Because the reservation was geographically located near the rapidly developing Tacoma area, Congress enacted legislation in 1893 which resulted in the forced sale and extreme reduction of reservation lands held in trust status (American Friends Service Committee, 1970). In 1988, the Puyallup Land Settlement Agreement was signed by the Puyallup Tribe of Indians, Pierce County, local governments, the State of Washington, the United States, private property owners and Union Pacific and Burlington Northern Railways. Both Congress and the Washington State Legislature enacted legislation confirming and implementing the Puyallup Land Settlement Agreement. The Settlement Agreement added acreage to the tribal land base, provided payments to individual tribal members, established a trust fund, provided funds for fisheries enhancement and preservation, established a job training and placement program, and provided social and health service improvements, as well as opportunities for tribal economic development.

The Muckleshoot Indian Tribe consists of the descendants of those people who lived along the Green, White, and Upper Puyallup Rivers. Additionally, it was not uncommon for members of the Muckleshoot Indian Tribe to intermarry with Duwamish people. The Muckleshoot Indian Reservation was established on Muckleshoot Prairie in 1857. The Reservation was authorized under the Treaty of Medicine Creek (1854), but located on

lands ceded by the Treaty of Point Elliott (1855). The present day Muckleshoot Indian Tribe is composed of Green River, White River, Upper Puyallup and Duwamish Indians (Hollenbeck, 1987).

Fishing for salmon, steelhead trout, and shellfish are central to the spiritual, cultural, subsistence, and economic well-being of members of both the Muckleshoot Indian Tribe and The Puyallup Tribe of Indians.

2.16.2 Historical resources

European exploration in the southern Puget Sound area was initiated by seafaring English during the late 18th century. This was closely followed by American merchant ships for the purpose of trade with the Indians. In 1833, the first white settlement on Southern Puget Sound was established at Fort Nisqually. The mid-1830s brought American fur traders west across the mountains. These established wagon routes facilitated the subsequent flow of settlers into this area during the mid-1840s. American settlement of Puget Sound started on the south and gradually moved north. The Donation Land Claim Act of 1850 promised large tracts of unsurveyed lands to almost anyone who would place a claim. The act caused a great influx of settlers to the Puget Sound area from the eastern United States (Warren, 1986).

Settlement around Commencement Bay began with a single saw mill in 1852. In 1868, a 164-acre townsite was surveyed by the developer Matthew McCarver. McCarver originally planned to name the site Commencement City, but instead selected the Indian name for Mt. Rainier - Tacoma. Tacoma essentially developed around the first saw mill. Hotels, houses, schools, stores, and a post office were soon to follow. In 1873, the Northern Pacific Railroad made the important decision to place the much sought after railroad terminus at Commencement Bay (Morgan and Morgan, 1984). With this impetus, the City of Tacoma and the southern Puget Sound area grew rapidly throughout the late 19th and early 20th centuries. This locality has been, and continues to be, dominated by the lumber industry, shipping, agriculture, and manufacturing.

2.16.3 Prehistorical resources

As of 1987, a total of 73 prehistoric archeological sites had been recorded within King County, and 101 in Pierce County. A total of 147 surveys were conducted in King County and 77 investigations in Pierce County, as of 1987. The majority of investigations have been situated in the coastal and lowland zones. Prehistoric site types in the southern Puget Sound area consist of shell middens, lithic scatters, wet sites, and rock shelters. Submerged archaeological sites and artifacts may exist in Commencement Bay. The chronology of human occupation in this area is not completely understood; however, there is evidence of habitation as early as 8,000 years ago.

Currently, the Office of Archaeological and Historical Preservation records for King County indicate 177 sites and districts are listed on the National Register of Historic Places; 42 sites

have been determined eligible, and six are designated National Historic Landmarks. Pierce County has 108 sites and districts which are currently listed on the National Register; four sites are determined eligible and five are designated National Historic Landmarks. The majority of the National Register sites in both King and Pierce Counties consist of historic buildings in urban areas. In addition to buildings, various bridges and ships are also included on the National Register.